Vol. 12, No. 22
November 30, 1987

Energy Research Abstracts

Abstracts 44815-47009

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

To provide immediate and complete coverage of literature related to major Department programs, the Office of Scientific and Technical Information provides an on-line retrieval system, data bases, and current-awareness publications. The Energy Data Base (EDB), which contains all unclassified, unlimited energy and nuclear related information processed by OSTI since 1974, and the Nuclear Science Abstracts Data Base (NSA), which covers nuclear information from 1948 through June 1976, are available for machine searching using commercial on-line retrieval systems. All information in the publications listed below, plus additional backup information, is included in the EDB. Current information being added to the EDB is available for on-line searching via the OSTI Automated Retrieval System (OARS) accessible to DOE and contractors through the Integrated Technical Information System (ITIS).

The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

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A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

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Energy Meetings (EM)

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***Acid Precipitation (APC)*–PB87-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Technology (BET)*–PB87-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB87-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)*–PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB87-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB87-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB87-900500.** Heavy-ion ($A > 4$) reactions.

***Laser Research (LAR)*–PB87-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB87-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00697-4 and the price is $142.00 for the Volume 11 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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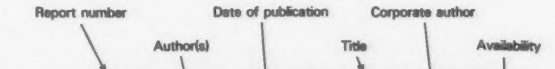
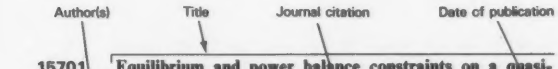
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Legibility Code

Abstract: Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract: Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

● Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

● Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
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● Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
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REVERSED-FIELD PINCH
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Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

● Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

● Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522 9:5785 NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
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National Institutes of Health
National Library of Medicine
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NOVA Information Services Company
Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

44815 (DOE/PETC/QTR—87/1) [Pittsburgh Energy Technology Center]: Quarterly technical progress report for the period ending December 31, 1986. (USDOE Pittsburgh Energy Technology Center, PA). Aug 1987. 167p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87014240.

In the Clean Coal Technology program, a series of fact-finding inquiries for the four proposals assigned to the Pittsburgh Energy Technology Center for negotiation was completed. Responses were received from each of the four proposers: Coal Tech Corp.; Ohio Ontario Clean Fuels, Inc.; Babcock and Wilcox; and Energy and Environmental Research Corp. All aspects of the Cooperative Agreement with Coal Tech Corp. were negotiated and the agreement was signed on December 24, 1986. Funding of the project, a demonstration of an advanced cyclone coal combustor, will be shared equally by DOE and Coal Tech Corp. Negotiations concerning the three other clean coal projects are proceeding, with all agreements anticipated to be finalized by September 30, 1987. Research in flue gas cleanup technology continued to produce important results. A PETC researcher was issued a patent on October 6 for inventing an advanced flue gas cleanup process. Hydrate Addition at Low Temperature (HALT) technology is a relatively low-cost, retrofittable method to clean coal-fired flue gas. DOE is sponsoring a 5-MW/sub e/ proof-of-concept test of this technology at Ohio Edison's Toronto Station under contract with Dravo Corp. Also under PETC's Flue Gas Cleanup Program, the University of North Dakota Energy Research Center (UNDERC) has developed a highly effective sorbent furnace injection concept based on pressure hydrated lime for SO_2 emissions control. As part of its contract with DOE to conduct proof-of-concept testing of the PETC Copper Oxide Process, UOP, Inc. has begun the first of two planned tests designed to determine the durability of the sorbent used in the process. The sorbent consists of aluminum oxide spheres impregnated with copper oxide. These tests will establish the long-term stability of the sorbent and provide data for scale-up of the process to the proof-of-concept level.

0103 Preparation

REFER ALSO TO CITATION(S) 44843, 44875, 44910

44816 (EUR—9804-EN) Membrane pressure plate filtration. Brown, D.W.; Jones, T.; Williams, J.W.L. (British Coal, London (UK)). 1986. 84p. Commission of the European Communities.

The report covers the work undertaken by the Mining Research and Development Establishment (MRDE) of British Coal into the use of membrane plates in pressure filters for the de-watering of fines and tailings suspensions. The investigations described were supported by ECSC funds from March 1981 to December 1984. Initial work into the use of membranes showed them to be a viable proposition for both reducing cycle time and hence increasing solids througpout rate, and for producing a cake with a moisture content lower than when using a pressure filter with conventional plates. It became apparent that it was not possible to obtain actual cake moistures and thicknesses to pre-set requirements due to errors in readings of the monitoring transducers as well as inaccurate values of solids ash content. The two transducers which created the largest errors were the filtrate and feed flowmeters. These were replaced but there were still inaccuracies due to the figure used for solids ash content. At this stage optimization of pressure filters utilizing membrane plates is not feasible using these methods due to the present state of transducer technology. It is recommended that when more accurate transducers become available the work is continued. Further work will be undertaken by MRDE to investigate other possible methods of optimizing the operation of pressure filters.

44817 (EUR—10724-DE) Development and testing of optimum comminution processes and equipment for the preparation of coal in a form adapted to new technologies. Leonhard, J.; Gwosdz, A. (Steinkohlenbergbauverein, Essen (Germany, F.R.)). 1986. 239p. (In German). Commission of the European Communities.

The different qualities of feed coal for the new technologies can satisfy requirements only with the help of crushing equipment and processes. Tests on various grinding systems are to form the basis for selecting machines and plant suitable for preparing the charge material required. The research outlined in the paper had the aim of determining the effects of the different types and intensities of forces applied in crushing different grades of coal. Tests on: impact crushing in a hammer mill; compression crushing in a cylinder crusher; a combination of compression and shear crushing; were carried out in a roller or centrifugal roller mill, a swing mill, and in a ball mill operating in batches. Tests on impact, compression and shear crushing of single grains added to the results obtained with collective pulverization. Five different prepared coal types were used as test material. The paper outlines the results of the tests and concludes that with methods based on surface induced changes in the wetting process, there is evidence that additional factors begin to affect the separation results obtained with freshly ground surfaces. Safe preparation of feed material for the new technologies is possible if a series of safety precautions are respected in the production, transport and storage of coal dust.

44818 (EUR—10799-EN) Preparation and injection of coal-water mixtures into a blast furnace. Malgarini, C.; Colacchi, B.; Bolignano, G.; Federico, G.; Pensa, R.; Mele, R. (Centro Sperimentale Metallurgico, Rome (Italy)). 1986. 62p. Commission of the European Communities.

The paper describes the main results of a three-year research project on the use of coal-water mixtures (CWM) in the blast furnace. Prior to the experimental work the range of flows which could be injected through all the tuyeres of a blast furnace was predicted. A process flow diagram was worked out for the preparation of coal-water suspensions with a high coal content, low viscosity and high static stability and on this basis a pilot CWM preparation plant with a capacity of about 3 t/h was designed and constructed and installed close to the No.1 blast furnace at the Taranto works of the Stabilimento Nuova Italsider, Italy and was connected to four tuyeres. Trials were also carried out on a pilot plant to investigate the preparation of CWM with a coal content of 70% and low apparent viscosity using an open-circuit ball mill. Work is currently in hand at the Nuova Italsider Taranto works on the construction of a plant to produce 100,000 tonnes per year of CWM to be injected through the tuyeres of the No.3 blast furnace.

44819 (NERDDP-EG—85-400) Investigation of the grinding process in an EVT mill - development of a process model. McIntosh, M.J.; Borthwick, I.R. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1984. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The means by which a small fan-type mill (EVT N 035) affects size reduction has been investigated using high speed cinematography together with size analysis of the pulverised products sampled from within the mill and on leaving the mill. The tests were conducted with raw coal in air at ambient temperature as a previous investigation had shown that grinding in hot gas was accomplished prior to significant drying of the coal. It was observed

that grinding occurred at the inlet of the rotor and within the volute.

0104 Processing

REFER ALSO TO CITATION(S) 44873, 44875, 44878, 44879, 44881, 44910, 44910, 45038, 45186, 45309, 45321, 45321, 45712, 45933

44820 (BMFT-FB-T—86-176) Mine gas as feed for a PSA-unit producing substitute natural gas resp. enriched methane. Final report. Pilarczyk, E.; Giessler, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.). Abt. Kohlechemie). Dec 1986. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87770254.

A new PSA-process for upgrading of methane from mine gas has been optimized and demonstrated in a pilot-PSA-unit at two different mines. The methane enriched product gas is produced during desorption using a special carbon molecular sieve. The product has the quality of town gas or SNG depending on the desorption method used. The adsorption pressure is 6-8 bar. During the following depressurization and purging methane is enriched up to town gas quality (about 50% by vol. CH/sub 4/). For a higher upgrading of methane up to SNG-quality (calorific value: 10,1 kWh/m/sup 3/) a vacuum pump must be used, SNG is then produced during evacuation. With 6 tabs., 9 figs.

44821 (BNL—39986) Mild gasification of coal. Steinberg, M.; Fallon, P.T.; Sundaram, M.S. (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 12p. (CONF-870659—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014394.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this program is to conduct research and development on the mild gasification concept for Eastern coals for the purpose of determining (1) the process chemistry, (2) the yield of liquid, gas, and solid co-products, and (3) the quality of liquid product. At BNL, an entrained flow reactor has been successfully operated for the rapid devolatilization of coal. The unit has a capacity of up to about 2 lbs/hr of coal. This equipment, however, requires modification so that mild gasification experiments can be adequately run over a range of conditions. Prior to completing the modification of the tubular reactor facility, two sets of runs were made for the purpose of collecting approximately 500 to 600 gm of liquid product for characterization. The Wellmore Kentucky No. 8 bituminous coal was used. One set was run without hydrated lime and one with hydrated lime addition to coal at 650°C, 30 psig, a heat-up rate of 2 x 10^4 °C/sec and accumulated coal particle residence time ranging from 25 min to 96 min. Nitrogen was used as a sweep gas. Table 2 gives a summary of the conditions and the product yields. Having completed the preliminary multi-gram liquid runs, the modification of the equipment and the design of the test matrix, the experimental runs will be conducted according to plan. The co-product yield data and co-product quality will be correlated with the conditions of the runs. In this manner, a firm data base will be established for eventual industrial applications. 3 refs., 2 figs., 4 tabs.

44822 (CONF-870994—1) Fossil energy environmental research including innovative concepts for wastewater, sludge, and product treatment. Scott, C.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010903.

From 6. conference on chemistry for protection of the environment; Torino, Italy (15 Sep 1987).

Some of the components of the waste stream, including hydrogen sulfide, ammonia, and phenol, may be present in sufficiently high concentrations to be recoverable by stripping processes or solvent extraction. However, the dephenolated liquors may require further treatment before the aqueous stream can be released or recycled. Biooxidation processes are under development for this application. At first, activated sludge systems with large, stirred-tank reactors were used. However, this method required many hours of residence time, and thus large tanks, to achieve the very low phenol levels that were required. More efficient fluidized-bed bioreactor systems, using microorganisms immobilized as a fixed film on suspended particles, seem to be much more appropriate for this application. Typically, microorganisms such as the commercial preparation PHENOBAC (Polybac Corporation, Berlin, NJ), are used to initiate the active bioreactor system. This immobilized biocatalyst is effectively retained in the bioreactor at high microbial concentration, and when oxygen or air is also introduced in sufficient quantities, the bioreactor system is much more efficient than the conventional stirred tank. For example, phenol degradation in the fluidized bed generally ranged from 10 to 50 kg/(m^3 . d) with inlet phenol concentrations of 20 to 200 g/m^3. This rate is 10 to 50 times higher than conventional activated sludge systems in stirred-tank bioreactors. Effluent phenol levels as low as 25 mg/m^3 were observed and other hazardous organic chemicals were also oxidized, including thiocyanates which were removed at a rate about 0.1 that of phenol. This type of bioreactor has exhibited stable biological activity for periods of several months with few operating problems. 9 refs.

44823 (CRIEPI—285080) A study on flow and mixing characteristics in the entrained-bed coal gasifier (Part 2). Inumaru, J. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1986. vp. (In Japanese). Central Research Institute of Electric Power Industry.

An experimental study was made to investigate the influence of changed gasifier shape on the flow and mixing processes in the gasifier. Two water flow models, different in their shape and size, were used for experimental flow simulations of A type and B type gasifiers. The advanced flow visualization system with light-scatter technique was utilized for measurements of tracer concentration in the mixing field of the water flow models. Improved flow and mixing characteristics were shown in the case of the B type gasifier. Furthermore, for the verification of water model simulations, other measurements were carried out; helium gas was injected into the 2 t/d gasifiers in operation through the burners as a tracer. From the measurements, it was confirmed that the water flow model could successfully simulate real 2 t/d gasifiers with respect to their flow patterns and the size of the reverse flow region.

44824 (CRIEPI-T—86033) Survey of the advanced gas separation membrane technology and its possible applications to electric power industry. Asakawa, C. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1986. vp. (In Japanese). Central Research Institute of Electric Power Industry.

This paper surveys advanced gas separation membrane technology and proposes its possible applications to the electric power industry. (1) The most advanced gas separation membranes are those which separate hydrogen from carbon monoxide, carbon dioxide from methane and enrich oxygen from air. (2) The available membrane which works at 400 C is a porous non-organic membrane made of bicole glass; the ceramics polyimide membrane works at 200 C, the highest temperature at which the organic membrane works. (3) Gas separation membranes are expected to be applied to the oxygen enrichment of coal gasification oxidizing air and carbon dioxide or hydrogen separation in molten carbonate fuel cells. (4) One of the most useful membranes in the future should be the ceramic gas separation membrane because many facilities in the electric power industry work at high temperature.

44825 (CRIEPI-W—86010) Study of 2T/D pressurized two stage entrained bed coal gasifier's characteristics. Takahashi, S. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1986. vp. (In Japanese). Central Research Institute of Electric Power Industry.

In order to design a large scale two stage entrained bed coal gasifier, it is necessary to know the relationship between combustor air ratio, gasifier total air ratio, and recycle char flow. The following were investigated from the data of a 2 t/d entrained bed coal gasifier test conducted using a Canadian coal: (1) Syngas flow; (2) carbon conversion efficiency; (3) char production rate; (4) relationship between combustor air ratio, gasifier total air ratio, and recycle char flow.

44826 **(CRIEPI-W—86016) Vaporization and condensation of alkali species in coal gasification streams.** Ito, S. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1986. vp. (In Japanese). Central Research Institute of Electric Power Industry.

In this report, the behaviour of trace species, mainly alkali compounds, is investigated theoretically in a coal gasification environment. (1) The behaviour of trace species in coal particles was modelled under high temperature. It consists of two mechanisms, one evaporation within a char particle and the other pore diffusion to the char surface. (2) The vapor of the metal compounds condenses on the char surface when the gas is quenched. The condensed matter on a particle increases with particle diameter but the concentration of condensed matter decreases with increasing particle diameter. (3) A model to estimate the concentration of trace species in a char particle was obtained. The model takes account of evolution and condensation, residual matter within a char particle after evaporation and the decrease of particle diameter. (4) As the char particles produced by coal gasification include many small particles, most of the volatile species, such as sodium, are included in small particles.

44827 (DOE/FE/60177—2305-Vol.1, pp 251-252) **Experimental testing of the TREE/sup sm/ process.** Mones, C.G.; Glaser, R.R. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The Total Resource Energy Extraction (TREE/sup sm/) process was designed to utilize two synthetic fuel resources, coal and oil shale, in a stratified in situ retort. In the TREE/sup sm/ process, a coal seam is gasified, and the resulting hot product gases are used to indirectly retort adjacent oil shale beds, producing shale oil. Indirect retorting of oil shale has advantages over direct combustion. Oil combustion losses are lower, retorting sweep efficiency is not dependent on establishing combustion fronts, and the produced shale oil is of higher quality than that produced from direct combustion retorts. The TREE/sup sm/ experiments conducted at Western Research Institute (WRI) were designed to simulate combined retorting studies. In addition to providing feasibility data for in situ liquid-extraction recovery, these tests were designed to resolve operational uncertainties with the TREE/sup sm/ concept. Previously, it had not been proven that a combusted UCG product gas could be used to retort indirectly oil shale beds of low porosity. The effect of sulfur dioxide in the combusted UCG product gas on oil shale retorting and oil product quality was also determined as was spent shale reactivity to sulfur dioxide in a retorting environment.

44828 (DOE/FE/60177—2305-Vol.1, pp 177-179) **Comparison of forward combustion gasification models.** Mones, C.G. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

A survey and comparison have been made of forward combustion gasification models that are available in the public domain. The models studied range in complexity from a simple constrained mass balance model to a two-dimensional unsteady-state model. Each model surveyed was based on different assumptions concerning the fundamental mechanisms of the UCG process and they vary greatly in their theoretical completeness, computational complexity, and predictive capabilities. The purpose of this research was to provide a direct comparison of input data requirements, computational capabilities, and computer time requirements for the public domain forward combustion gasification models. In addition, analyses were computed with each of the codes using data to simulate representative DOE sponsored field experiments at Hanna, Hoe Creek, Rawlins, and Pricetown.

44829 (DOE/FE/60177—2305-Vol.1, pp 179-182) **Effect of pressure on subbituminous coal gasification.** Glaser, R.R.; Johnson, L.A. Jr. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Data from the Rawlins underground coal gasification (UCG) field tests show a strong correlation between methane concentration in product gas and UCG cavity pressure, while data from the Hanna, Hoe Creek, and Pricetown UCG tests do not clearly show such a correlation. Because of operational and geologic variations in the field test data, it is very difficult to determine the effect of pressure on horizontal UCG process performance from field test data alone. A study of methane production in UCG processes under more carefully controlled pressure conditions has been needed. The objective of this work was to study the effect of pressure on horizontal UCG performance. Cavity growth mechanisms, gasification chemistry and methane production were also studied. Results of the experimental study were compared with actual field data.

44830 (DOE/FE/60177—2305-Vol.1, pp 183-185) **Gasification of bituminous coal.** Glaser, R.R.; Johnson, L.A. Jr. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Underground coal gasification (UCG) is an in situ technology directed at the utilization of nonminable coal seams to produce usable gases and liquids. The technical feasibility of various UCG design options in western coals (nonswelling subbituminous) has been proven with a number of field demonstration programs. However, the feasibility of UCG technologies in swelling bituminous coals has not been proven. The concerns specific to the bituminous coals occurring in the eastern US are the low permeability, swelling tendency, tar production, coal reactivity, and geologic setting of the coals. These concerns can be addressed through laboratory studies. The objectives of this experimental series were to identify process conditions that will promote sustained in situ gasification of bituminous coals; to identify the mechanisms responsible for reactor growth in a borehole-linked system in bituminous coal; to measure the gas quality from in situ gasification of bituminous coal; and to identify the effects of the swelling tendency on the gasification performance of bituminous coal.

44831 (DOE/FE/60177—2305-Vol.1, pp 186-189) **UCG with steam and oxygen mixtures.** Glaser, R.R.; Johnson, L.A. Jr. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Sustaining gasification has been difficult in laboratory and field testing of underground coal gasification (UCG) in bituminous coals when air has been used. In addition, air gasification of coal produces a product gas containing high percentages (> 50% by volume) of nitrogen. Gasification with steam and oxygen mixtures produces a product gas with little nitrogen. In addition, higher process temperatures are possible with steam and oxygen gasification, extending the temperature into a range where sustained gasification may not be problematic. The objective of this research was to evaluate gasification performance in the bituminous coal at various steam and oxygen ratio and compare this performance with the gasification of a subbituminous coal under similar conditions.

44832 (DOE/FE/60177—2305-Vol.1, pp 189-195) **Postburn evaluation of the Hanna Iva and B UCG experiments, Wyoming.** Oliver, R.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process

technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The Laramie Energy Technology Center (LETC), presently the Western Research Institute (WRI), completed several underground coal gasification (UCG) field tests near Hanna, Wyoming. To assist in the evaluation of these experiments, postburn coring of the sites was conducted, along with downhole well logging and detailed coal and overburden core analyses. The drilling results, well logs, and core analyses, combined with process and monitor well histories, made detailed interpretation of cavity formation and extent of affected coal and overburden possible. Postburn evaluation of UCG experiments was performed to further understand the UCG process and assist in technological advances. Detailed information on mineralogic changes and cavity delineations provide valuable information on operating temperatures, paths of advancing burn fronts, roof interactions, and structural controls. All of these can strongly affect product gas quality and duration of burns. Perhaps more vital is the ability to relate process events and postburn conditions to preburn geological and mineralogical characteristics. This correlation is a major data source for developing reliable predictive modeling technologies for use on future experimental and commercial projects.

44833 (DOE/FE/60177—2305-Vol.1, pp 195-199) **Postburn evaluation of the Tono I UCG experiment, Centralia, Washington.** Oliver, R.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The Lawrence Livermore National Laboratory (LLNL) ad the Washington Irrigation and Development Company (WIDCo), with funding from the US Department of Energy (DOE), conducted an underground coal gasification test at the WIDCo mine site near Centralia, Washington. This test was conducted in the upper 20 feet of the 35-foot-thick Big Dirty coal seam. The coal seam, consisting of a high-ash, subbituminous coal, dips to the northeast at angles ranging from 8 to 14 degrees. The 20-foot section is isolated from the remainder of the coal seam by a high-ash parting. The Western Research Institute (WRI) performed a drilling, coring, and geotechnical evaluation program at the test site in the spring of 1984 to delineate the extent of the coal seam that was thermally affected as a result of gasification and to provide information for process analysis. The three main objectives of the study were to identify the shape, size, and location of the reactor cavity and its associated affected areas; to delineate the lithologic and structural controls on the process and reactor cavity development; and to evaluate the effectiveness of the various geotechnical techniques in delineating the extent of the reactor cavity and adjacent affected regions.

44834 (DOE/FE/60177—2305-Vol.1, pp 199-201) **Tono II site characterization project.** Oliver, R.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The DOE synfuels research program continues to support underground coal gasification (UCG) as a method of increasing the usable reserves of coal in the US. A recent UCG venture was a joint DOE-industry cooperative effort to conduct a two-module burn in coal located on the Washington Irrigation and Development Company (WIDCo) property near Centralia, WA. The major objective of the site characterization program was to select a site suitable for the test. The test site was to be selected based on how well the geologic and hydrologic characteristics compared with predetermined site selection criteria. These criteria included, but were not limited to, coal and overburden thickness, coal permeability, coal seam dip, occurrence and thickness of partings, structural conditions (faults and fractures), hydrology, and consolidation of overburden material. Minimum and maximum values for these criteria were established as well as preferred values.

44835 (DOE/FE/60177—2305-Vol.1, pp 201-204) **Rocky Mountain I site characterization.** Oliver, R.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

As a continuing effort to advance UCG technology, a dual-module test is planned for the fall of 1987. The test was previously to take place on Washington Irrigation and Development Company (WIDCo) mine land near Centralia, WA, but because of contractual problems, the site was abandoned. As a result, a new site was selected near the old Hanna, Wyoming, UCG sites. The preliminary location of the Rocky Mountain I test site was determined through analysis of existing site characterization data available from the Hanna tests. Desirable site characteristic parameters were compared against existing data to locate a site that best met all of the criteria. The main objective of the site characterization program was to verify site suitability for the planned UCG tests and to delineate the coal seam geometry and quality. Other parameters to be evaluated included structural characteristics, cleating and fracturing, and the lithologic nature of the adjacent overburden unit. Wells to be installed as water monitoring wells were also used to evaluate the site since drill cuttings and geophysical log data were available for these wells also.

44836 (DOE/FE/60177—2305-Vol.1, pp 204-206) **Alternative uses for underground coal gasification.** Trudell, L.G. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Standard approaches to the application of underground coal gasification (UCG) technology have generally focused on the use of low heating value process gas for generation of electricity at local, captive power plants, or conversion of synthesis gas to methanol and gasoline. Opportunities for alternative uses of UCG probably exist almost any place that coal deposits unsuited for mining occur and thermal energy is needed nearby. Fossil fuel industries might use large amounts of heat to produce liquid hydrocarbons from tar sands, heavy oil deposits, oil shales, lignite or coal, or for thermally enhanced oil recovery from residual oil fields. The objectives of Western Research Institute's investigations were to identify fossil fuel resources located sufficiently close to coal deposits to permit application of UCG combustible gas or sensible heat in recovery of oil, and to provide preliminary evaluations of the spatial and geological relationships between these associated fossil fuel and coal resources. Investigations and surveys were made for resources of tar sand, heavy oil, residual oil and oil shale. Resources suitable for coal-to-coal applications, in which thermal energy from UCG processing of one coal bed would be applied to produce useful hydrocarbons from another coal bed, are so abundant that a search is unnecessary.

44837 (DOE/FE/60177—2305-Vol.1, pp 206-209) **Enhanced recovery of pyrolysis products.** Barbour, F.A. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Coal pyrolysis has been studied for decades and is still an active area of coal science research. Much of the emphasis of current studies involves high temperatures ($> 1000°C$ or $> 1832°F$) and/or high heating rates to model surface gasification and combustion processes. Underground Coal Gasification (UCG) processes, however, occur at much lower heating rates, so pyrolysis is an important reaction and, in fact, may produce a substantial portion of the product gas as well as liquid organic product. The objective of this project was to examine low temperature pyrolysis of Hanna coal as it relates to UCG. The kinetic data on coals that are candidates for UCG development should be useful in interpretation and analysis of UCG field tests. Comparison of coal tars from previous Hanna UCG tests and coal tars generated by pyrolysis should also help in achieving this objective.

44838 (DOE/FE/60177—2413) Results of leaching experiments conducted on samples from the Tono I UCG cavity. Oliver, R.L.; Spackman, L.K. (Western Research Inst., Laramie, WY (USA)). Jun 1987. Contract FC21-83FE60177. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014458.

Laboratory experiments were conducted to characterize leachate chemical composition from heat-affected coal and overburden material. The experiments were designed to identify the major leachate constituents, the major heat-affected rock types contributing to leachate, and the general geochemistry involved in the degradation of groundwater. Thirty-day batch equilibrium experiments were conducted using a 1:5 solid-to-solution ratio. Five material types were subjected to leaching: coal heated to 300, 400, and 500°C (570, 750, and 930°F), slag, and altered overburden. The mineralogy of the material was determined by x-ray diffraction following preconcentration of mineral phases by density separation. The material was leached with deionized water maintained at a temperature of 25°C (77°F). Water samples were taken at 1-, 4-, 15-, and 30-day intervals to evaluate change in leachate composition over time. Results indicted no significant or regular change greater than analytical accuracies in concentrations of constituents in the leachate over the 30-day time period. Greater concentrations of constituents were leached from the char and ash (by an order of magnitude) than from the slag and altered overburden with the major constituents being calcium, magnesium, sodium, sulfate, and associated total dissolved solids. Minor constituents leached from the char were boron, ammonia, and total organic carbon. The minor constituents were generated from the pyrolysis of coal releasing much greater concentrations during the actual gasification process than during leaching. 5 refs., 2 figs., 7 tabs.

44839 (DOE/MC/20230—2276) CNG acid gas removal process: Final report. Liu, Y.C.; Auyang, L.; Siwajek, L. (CNG Research Co., Pittsburgh, PA (USA)). Aug 1986. Contract AC21-83MC20230. 283p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87001061.

The CNG process removes sulfur compounds, residual trace contaminants, and carbon dioxide from synthesis gas mixtures at temperatures near the carbon dioxide triple-point, and is especially suited for medium to high pressure (300 to 1000 psia) gas streams containing substantial amounts of carbon dioxide. Hydrogen sulfide, other sulfur compounds, and trace contaminants are removed by absorption in liquid carbon dioxide. Pure liquid carbon dioxide absorbent is regenerated, and sulfur compounds and trace contaminants are concentrated, by triple-point crystallization. Carbon dioxide is absorbed from contaminant-free crude gas with a refrigerant slurry of solid carbon dioxide in an organic carrier liquid. The first two CNG process features, hydrogen sulfide absorption with liquid carbon dioxide and carbon dioxide regeneration by triple-point crystallization, were further developed by the work reported here. DOE Contract AC21-83MC20230 comprised three tasks designed to advance development of the CNG acid gas removal process: Task 1 - modification and operation of a carbon dioxide triple-point crystallizer; Task 2 - design, construction, and operation of a sulfur compound absorber using liquid carbon dioxide absorbent; and Task 3 - integration of the crystallizer and the absorber. 11 refs., 40 figs., 74 tabs.

44840 (DOE/MC/21004—2398) Expansion of high-temperature: High-pressure data set for coal gasification: Quarterly report for the period December 28, 1986-March 28, 1987. Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Deshpande, G.V.; Kroo, E. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Mar 1987. Contract AC21-84MC21004. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006513.

Data collection on the CO_2 gasification matrix was completed for three size cuts (100 x 150, 200 x 270, 325 x 400 mesh). The results for char yield indicate a downward trend with increasing severity, as expected. The trends for the gas yields are also in accordance with expectations, although more widely scattered. A series of chars was selected for gasification experiments. The objective is to determine how char formation conditions affect char gasification rates. Chars were selected from the previous coal pyrolysis and CO_2 gasification experiments to determine the effects of heating rate, final temperature and time, pressure, and ambient gas on char reactivity. Many of these chars have already been subjected to characterization by elemental analysis, mineral analysis, SEM, surface area, and reactivity toward CO_2 and O_2 in a standard TGA experiment. A preliminary analysis was made of char sulfur measurements by the AFR x-ray microanalysis system. It appears that both the organic and mineral sulfur contents decline in the early stages of pyrolysis and then increase to slightly above the values of the raw coal. Scanning electron micrograph pictures of several chars produced in the pyrolysis experiments have been examined. Evidence of softening behavior was observed for some of the chars produced at high heating rates in the heated tube reactor (HTR). A plot of the reactivity measurements versus char hydrogen content for Montana Rosebud coal was made on a master plot with comparable data from other coals.

44841 (DOE/MC/22064—2407) Injection of densely loaded flows into entrained-flow gasifiers: Sixth quarterly report, January 1, 1987-March 31, 1987. Kollrack, R.; Edelman, R.B. (Science Applications International Corp., Chatsworth, CA (USA)). Jun 1987. Contract AC21-85MC22064. 12p. (SAIC/QPR—690-6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014776.

The overall objective of this project is to develop improved understanding of the injection and mixing of densely loaded gas/solid mixtures into gas streams. The ultimate application of the results will be the development of improved injection and mixing configurations for entrained-flow coal gasifiers. During the past quarter, theoretical investigations were mainly directed towards improving the multi-phase flow model for dense loadings and implementing these improvements in the computer code. The treatment of the particle-particle interactions and of the collision frequency was completed. Preliminary calculations were performed for inlet conditions outlined in the proposed test matrix for laminar jet flows. Experimental investigations concentrated on interfacing the LDV system to Sandia's data acquisition computers. This involved establishing the capability of discriminating between the signals received from the gas seed material and the signals from the particles of the dispersed phase. 1 ref., 3 figs.

44842 (DOE/MC/22064—2408) Injection of densely loaded flows into entrained-flow gasifiers: Seventh quarterly report, April 1, 1987-June 30, 1987. Kollrack, R.; Edelman, R.B. (Science Applications International Corp., Chatsworth, CA (USA)). Aug 1987. Contract AC21-85MC22064. 11p. (SAIC/QPR—690-17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014777.

The overall objective of this project is to develop improved understanding of the injection and mixing of densely loaded gas/solid mixtures into gas streams. The ultimate application of the results will be the development of improved injection and mixing configurations for entrained-flow coal gasifiers. During this past quarter, theoretical investigations were mainly directed towards model calculations on laminar jet flows for comparison with experimental results and on turbulent jet flows characterized by strong dampening of the turbulent kinetic energy due to high particle loadings. Experimental investigations concentrated on taking velocity and concentration measurements of laminar jet flows under varying loading conditions. 3 figs.

44843 (DOE/MC/23288—2406) Steam conditioning of coal for synfuels production: First quarterly report, January 1 to March 31, 1987. Graff, R.A.; Zhou, P.; Brandes, S.D. (City Coll., New York (USA)). 1987. Contract AC21-87MC23288. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014778.

Conditioning of coal in steam is being explored for the purpose of improving the yield and quality of condensable product obtainable in the mild gasification of coal. Test plans for both Tasks 1 and 2 were prepared. The first was accepted by DOE, the second is being revised. A new steam conditioning reactor system was constructed using a fluid bed heater to improve temperature control and uniformity. This unit has been put into routine operation, and the test program to determine the effect of operating pressure on steam conditioning has been initiated. The semicontinuous pyrolysis

reactor has been modified for steam operation at elevated pressure. Operation has proven satisfactory in runs at pressures up to 500 psia. A preliminary design for a fluidized-bed mild gasification test facility has been drawn up. 7 figs., 1 tab.

44844 **(DOE/MC/23289—2409) Development of mild gasification process: Quarterly report for the period April-June, 1987.** Chu, C.I.C.; Gillespie, B.L. (UCC Research Corp., Bristol, VA (USA)). Jul 1987. Contract AC21-87MC23289. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014775.

Reactor diameter optimization testing began with tests on 8-inch and 4-inch reactor tubes. The tests were conducted in non-tapered stainless steel reactor tubes. The tests to date have demonstrated several points. First, straight reactor tubes can be used in place of tapered tubes in the MGU. Straight reactor tubes (stainless steel pipe) have the advantages of being cheaper and more convenient to use than tapered, cast reactor tubes. Also the tests have shown that the increased heating rate obtained with a 4-inch reactor tube resulted in only a slight increase in the liquid yield. Coal and char combustion tests were conducted to investigate the possible use of char in industrial/utility pulverized coal boilers. The TAS-Combustion System, which takes up to 2 inch x 0 feed through its micronizer to a turbo combustor, was chosen for the tests. The char burned successfully in the TAS-System and in some aspects performed as well as or better than coal. SO_2 and NO/sub x/ emissions were lower for char than for coal, but the combustion efficiency and flame temperature of coal were slightly higher than those of char. It was found that generally the char did not require support fuel except when turn down ratio of char was as much as 12 to 1 whence a small amount of support fuel is needed to stabilize the flame. Based on the data obtained during the tests, the engineers at TAS, Inc., believed that the char would be an acceptable fuel in several applications. 8 refs., 5 figs., 2 tabs.

44845 **(DOE/PC/60050—6) Improved coal liquefaction using carbon-supported hydrogenation catalysts: Quarterly report for the period 1 January 1985-31 March 1985.** Scaroni, A.W.; Derbyshire, F.J.; Abotsi, G.M.K.; Solar, J.M.; Spears, R. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Mar 1985. Contract AC22-83PC60050. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014861.

Pretreatment of the Ambersorb XE-340 carbon by acids and oxidizing agents was found to reduce the activity of the Mo/C catalysts which were subsequently prepared. The modified supports and the catalysts prepared on these supports were examined by Fourier Transform Infrared Spectroscopy in a diffuse reflectance mode. From comparisons of the spectra it is suggested that the interaction of metal species with specific surface groups such as aromatic ring substituents can promote catalyst activity. The removal or modification of these sites by the pretreatments may be responsible for the loss of activity. It is further proposed that aliphatic groups, possibly containing C = C bonds, are more preferred sites for the attachment of metal species than aromatic systems. Pretreatment of the support by reaction with NH_3 at 400 and 600°C considerably enhanced catalytic activity, reasons for which are not clear. In all cases, for the catalysts with higher activities there was a marked change in the FTIR spectra after impregnation, indicative of a chemical interaction between the support and metal species. 5 refs., 9 figs., 2 tabs.

44846 **(DOE/PC/60050—7) Improved coal liquefaction using carbon-supported hydrogenation catalysts: Quarterly report for the period 1 April-30 June 1985.** Scaroni, A.W.; Derbyshire, F.J.; Abotsi, G.M.K.; Solar, J.M.; Spears, R. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Jun 1985. Contract AC22-83PC60050. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014862.

The overall objective of the contract is to prepare and investigate carbon-supported metal catalysts with respect to their hydrogenation and hydrodesulphurization activities and to examine their application to the direct liquefaction of coal and to the hydrotreatment of coal liquids. To accomplish these aims, the following specific tasks will be undertaken: Task 1, preparation of glassy carbon and carbon-black composite supports; Task 2, preparation of mesopore carbons; and Task 3, evaluation of carbon supported catalysts. During the past quarter, further work has been directed towards producing and characterizing a glassy carbon support with a bimodal pore size distribution. A second commercially supplied mesopore carbon has been used for the preparation of Mo loaded catalysts. Major operating difficulties are still being encountered with the continuous flow micro pilot plant system which is to be used for catalyst activity measurement. The principal problems relate to the operation of the Robinson gradientless reactor. These problems are being addressed with the cooperation of the vendor, Chemical Data Systems. In the interim, it has been decided to proceed with a program of catalyst evaluation using one of the fixed-bed reactors. 4 refs., 2 tabs.

44847 **(DOE/PC/60797—16) Intermediates formed during supercritical desulfurization of coal: Sixteenth quarterly technical progress report, April 1, 1987 to June 30, 1987.** Muchmore, C.B.; Chen, Juh W. (Southern Illinois Univ., Carbondale (USA). Dept. of Mechanical Engineering and Energy Processes). 1987. Contract FG22-83PC60797. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013070.

Last month, data was presented on a series of eight runs performed in the two liter reactor system under different reaction conditions, utilizing an Illinois No. 6 coal. The coal and solvent charges were held constant at 200 g each for all runs, and reaction time was one hour at a reaction temperature of 350°C. Four of the runs utilized coal that had been treated with nitric acid solution, employing the ASTM procedure for sulfur forms analysis to remove the pyritic sulfur prior to reaction with alcohol. Both methanol and ethanol were utilized, and the effect of potassium hydroxide addition in an amount equal to 5% of the coal charged was also evaluated. Table 2 from last quarter's report is included here as Table 1 for convenient reference; it summarizes the processing conditions employed, desulfurization attained, and material balance information for the series of eight runs. The main objective of this series of runs was to permit a comparison to be made of the fluid phase composition between the various treatments employed; maximum desulfurization was not possible due to the current lower pressure limitation of the two liter reactor. Chromatographic analyses of the sulfur compounds present in the fluid phase samples taken during the course of the reactions are presented in Figures 1 through 8. All samples were collected at temperatures above supercritical. Vertical lines indicate the time during which the reaction temperature of 350°C was maintained. The left vertical line denotes the end of the preheating time period, whereas the right one indicates the last data point completed before the final venting was performed. Relatively little fluid was removed from the reactor by sampling during the main reaction period. 8 figs., 1 tab.

44848 **(DOE/PC/70799—T9) Identification of nonvolatile coal derived products via chromatography coupled with on-line FTIR detection: Quarterly progress report for the period September 1, 1986-November 30, 1986.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Aug 1987. Contract FG22-84PC70799. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013806.

The analysis of nonvolatile coal-derived liquefaction products for minor and trace components which contain nitrogen, oxygen or sulfur presents unique challenges. Justification for their analysis rests on the premise that heteroatom-containing materials can aid and/or hinder the conversion process. This proposal builds upon our efforts during the initial three year grant period regarding the interfacing of Fourier transform infrared spectrometry with size exclusion and normal phase chromatography for the analysis of coal-derived products. Four objectives are proposed: (1) optimize the HPLC-FTIR interface in terms of detectability, identifiability and chromatography, (2) extend the HPLC-FTIR approach to reversed phase chromatography wherein more efficient separations are possible for heteroatom species, (3) determine the feasibility of interfacing supercritical fluid chromatography with FTIR for the analysis of coal-derived products and (4) employ hyphenated methods to ascertain on a molecular level the changes that occur in a nonvolatile coal derived product when various liquefaction parameters are varied. 25 refs.

44849 (DOE/PC/71257—T11) Novel experimental studies for coal liquefaction: Quarterly progress report, April 1, 1987 to June 30, 1987. Holder, G.D.; Shah, Y.T.; Tierney, J.W. (Pittsburgh Univ., PA (USA)). 1987. Contract FG22-84PC71257. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013506.

In Task 1 of this project, the use of a slurry reactor for indirect coal liquefaction is being studied. Work is being done using three indirect liquefaction routes involving synthesis gas - the Fisher-Tropsch reaction, the one-step conversion to methanol, and the two-step conversion to methanol via methyl formate. Experimental work and data analysis for the two-step methanol synthesis in a single slurry reactor were continued during the quarter. Experimental work included the effect of the H_2/CO ratio on the simultaneous reactions and measurements of the solubility of hydrogen and CO in methanol and methyl formate. Reaction rates obtained experimentally for the simultaneous system were compared with rates calculated from the individual reactions. The two-step methanol synthesis involves two reactions, and one of the reactants in each reaction is a gas. The carbonylation of methanol requires CO and the hydrogenolysis of methyl formate requires H_2. The ratio of H_2 to CO is therefore a very important operating parameter, affecting the relative rates of the two reactions and the total methanol production rate. It may also affect the selectivity of the two reations. Two runs were made, one at a temperature of 121°C and the other at 140°C. All reaction conditions were constant except for the H_2/CO ratio. The experimental procedure was the same as described previously. 61 refs.

44850 (DOE/PC/80516—8) Control of catalyst deactivation with ammonia: Quarterly report for period June 1, 1987 to August 31, 1987. Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract FG22-85PC80516. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014213.

We have shown in previous work that subjecting a catalyst deactivated by carbonaceous deposits to a NH_3/H mixture can cause substantial rejuvenation. We postulated that the NH_3 was displacing some strongly adsorbed species. To test this idea we have carried out a series of studies on the hydrogenation of phenanthrene in the presence of low levels of PyTHQ, a highly basic and adsorptive organonitrogen compound. When the PyTHQ was removed, the catalyst recovered only a portion of its original activity, and that very slowly. If, however, the catalyst was was treated (after PyTHQ removal) with NH_3 or decylamine, nearly the original activity was recovered, and that relatively rapidly. The more definite studies are reported in more detail.

44851 (DOE/PC/80906—7) Catalytic methods for improved coal liquefaction and hydrotreating: Quarterly report No. 7 for the period March 23, 1987 through June 22, 1987. Hirschon, A.S.; Laine, R.M.; Wilson, R.B. Jr. (SRI International, Menlo Park, CA (USA)). Jul 1987. Contract FG22-85PC80906. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013520.

(1) In previous experiments we found that reducing the ruthenium concentration of the RuCoMo catalysts from 3.9 wt% to 2.1 wt% only slightly changed the HDN activity and selectivity. To determine the extent of further reduction in ruthenium content, we synthesized a new RuCoMo catalyst with a ruthenium concentration of 0.33 wt%. We also synthesized a second RuCoMo catalyst that was sulfided at 400°C for comparison with the RuCoMo catalysts sulfided at lower temperatures. (2) We found that low ruthenium concentration catalyst, RuCoMo(0.33), still had high HDN activity, but the selectivity was less than the previous promoted catalysts with higher ruthenium contents. The results form the RuCoMo catalyst sulfided at 400°C showed similar HDN activity but increased selectivity over the catalysts sulfided at 200°C. The selectivity was similar to that found for the RuCoMo catalyst prepared from ruthenium chloride, which was also sulfided at 400°C. Thus, the increased selectivity appears to be due to the higher sulfiding temperature rather than the ruthenium precursor. We also tested our catalysts on diphenyl ether, which undergoes HDO and hydrogenation reactions to form benzene and cyclohexane. We found that the catalyst activity was in the order Ru(OM) > CoMo > WCoMo > RuCoMo. However, the selectivity toward aromatic products was in the reverse order, with the RuCoMo catalyst giving the greatest proportion of benzene relative to cyclohexane. (3) We compared the effects of CoMo and RuCoMo on the liquefaction of Illinois No. 6 coal in the presence of tetralin and hydrogen and found that the RuCoMo was more effective in conversion of the coal to toluene-soluble material. 6 refs., 8 tabs.

44852 (DOE/PC/90017—T10) Cooperative research in coal liquefaction infratechnology and generic technology development: Quarterly report, April 1, 1987-July 1, 1987. Sendlein, L.V.A.; Huffman, G.P. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). 1987. Contract FC22-86PC90017. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013815.

Progress on the following tasks related to coal liquefaction is reported: (1) biologically enhanced coal liquefaction; (2) desulfurization of coal by Sulfolobus brierleyi under controlled conditions; (3) biochemical investigations of Sulfolobus brierleyi; (4) growth and maintenance of cultures; (5) coal liquefaction by homogeneous catalysts; (6) coprocessing of coal with heavy oil and petroleum; (7) EPR and optical studies of coal depolymerization via charge-transfer complexation; (8) ESR, ENDOR and electron spin echo characterization of free radicals and catalytically-active sites in metal-oxide catalysts; (9) magnetic studies of pyrolysis and hydrocarbonization coals with and without catalysts; (10) solvents and coal dissolution; (11) comparison of the selectivity of oil soluble catalysts to other hydrotreating catalysts; (12) coprocessing with catalysts of increased macroporosity; (13) coal liquids modification for enhanced reactivity; (14) solvent extraction of resin-rich coal; (15) spectroscopic analysis-MS, IR, NMR; (16) collect and characterize coals from Eastern Kentucky; (17) direct liquefaction conversions of collected coals.

44853 (DOE/PC/90521—T3) Role of porosity in supercritical fluid extraction of coal: Technical progress report. Bale, H.D. (North Dakota Univ., Grand Forks (USA)). 1 Sep 1987. Contract FG22-86PC90521. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014219.

We have performed a series of in situ small angle scattering experiments from Beulah lignite before and after supercritical extraction with toluene as the extracting fluid. Our data analysis of these measurements is reasonably complete, and the results that we have established are presented in this report. 4 refs., 4 figs., 1 tab.

44854 (DOE/PC/90523—T1) Phase equilibrium data for development of correlations for coal fluids: Report period, February 1, 1987 to August 15, 1987. Robinson, R.L. Jr.; Gasem, K.A.M.; Ross, C.H. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 1987. Contract FG22-86PC90523. 48p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014017.

During this report period, a study was completed of the abilities of the Soave (SRK) and Peng-Robinson (PR) equations of state to represent the phase behavior of ethane + n-paraffin and CO_2 + n-paraffin systems. As reported earlier, such cubic equations are capable of well describing the phase behavior of the systems considered. Depending on the level of precision desired, however, various degrees of complexity are required in defining the mixing rules used in the equations. For ethane/CO_2 + n-paraffin binary systems extending from C_3 to n-C_{44}, a precision of about 1% is obtained for the bubble pressure and 0.005 mole fraction in solubility predictions when two interaction parameters per isotherm are used. Simple generalized correlations are presented for the EOS interaction parameters which allow prediction of the bubble point pressures with an expected uncertainty of about 4%. 44 refs., 11 figs., 8 tabs.

44855 (DOE/PC/90526—4) Partial oxidation of light alkanes in transition-metal ion containing zeolites. Klier, K.; Lange, J.P. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90526. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014557.

A reaction apparatus has been designed for studying the partial oxidation of light alkanes in transition-metal ion containing zeolites. It consists of a vacuum line which is equipped with a quadru-

pole mass analyzer and with a reactor-cell for in situ diffuse reflectance measurements. This apparatus will allow a simultaneous investigation of the state of the metal cation, of the nature of the adsorbed molecules and of the composition of the desorbed gases. Volumetric adsorption measurements are rendered possible by the presence of a differential membrane manometer. Representing a promising system for the pursued reaction, the reversible [Cr(III)-O/sub anti 2] complex observed in A type zeolite has been investigated. A detailed shape analysis of the reported adsorption isotherm revealed the presence of a small repulsion or relaxation energy of 6.4 $kJ.mol^{-1}$. Using the statistical thermodynamics a heat of adsorption of 62.3 $kJ.mol^{-1}$ could be derived from the calculated adsorption equilibrium constant. 6 refs.

44856 **(EUR—10486-EN) CEC sub-programme of R & D on new energy vectors.** Glynn, P. (Darone, Sandyford (Ireland)). 1986. 33p. Commission of the European Communities.

The European Community may provide a potential market for about 245 mtoe/year of synthetic fuels in the early part of the 21st century. A broad range of light hydrocarbons will be required and these synfuels could be produced from coal or biomass. Analysis in terms of the Commission R & D Policy shows that synfuels from coal is a more promising subject for R & D in Europe than is synfuels from biomass, with the future contribution of synfuels from biomass being marginal. Although involvement in synfuels from biomass could be useful for aiding developing countries and offering more environmental protection, synfuels from coal have considerably more overall promise and this is reflected by the actual spending of the member states on synfuels R & D. Spending by the Commission has, however, been minimal to date and has had emphasis on synfuels from biomass. A redirection of R & D effort towards synfuels from coal is suggested. This can best be achieved by confining future R & D under the New Energy Vectors sub-programme to synfuels from coal.

44857 **(EUR—10800-DE) Chemical and physical valorization of coal.** (Steinkohlenbergbauverein, Essen (Germany, F.R.)). 1986. 64p. (In German). Commission of the European Communities.

The 14 subjects studied under this research programme may be divided into three groups: coal liquefaction and coal extraction; thermal valorization of hard coal; and valorization of coking by-products. Basic research on coal liquefaction was carried out, in particular the effect of reaction gas composition on liquefaction was investigated. Comparative studies on the catalytic effects of various iron compounds on coal hydrogenation are carried out. Rapid hydrocracking was applied to three coals in order to study its influence on coke blend and coking behaviour. A further main item of study was the fluidized bed extraction of hard coal. The influence of a guanidine emulsifying agent on coal hydrogenation was studied and asphaltenes and asphaltoles produced from hydrogenation were also studied. Other topics studied were: the Beekmann molecular transformation of oximes from coal oxidation; coal analysis including petrographical studies of hydrogenation residues and NMR spectroscopic studies of non-boiling cracking products; the link between the fluorescence of vitrinites and the technological characteristics of coal; rheological behaviour of softening hard coals; influence of hard-coal bitumen on coking characteristics; influence of oxygen on the kinetics of partial steam gasification and pore structure; and the catalytic dehydrogenation of β-isopropyl-naphthalene to form β-isopropenyl-naphthalene.

44858 **(NERDDP-EG—83-224) Preparation and optimisation of coal hydrotreating catalysts.** Trimm, D.L. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1983. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

The objectives of the work and the progress achieved may be summarized as (i) to develop a high pressure computer controlled testing rig for continuous testing of coal liquid hydroprocessing catalysts; (ii) to prepare catalysts based on combinations of cobalt, molybdenum, nickel and tungsten designed to hydroprocess coal and coal liquids; and (iii) to test these catalysts for activity, selectivity and life using primarily coal liquids and, as a result, to optimise hydroprocessing catalysts.

44859 **(ORNL/FMP—87/1) AR and TD Fossil Energy Materials Program: Semiannual progress report for the period ending March 31, 1987.** (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 628p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE87014977.

The objective of the AR & TD Fossil Energy Materials Program is to conduct research and development on materials for fossil energy applications with a focus on the longer-term and generic needs of the various fossil fuel technologies. The program includes research aimed toward a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial enhancement of plant operations and reliability. The management of the Program has been decentralized to the DOE Oak Ridge Operations Office (ORO) and the Oak Ridge National Laboratory (ORNL) as technical support contractor. The ORNL Fossil Energy Materials Program Office compiles and issues this combined semiannual progress report from camera-ready copies submitted by each of the participating subcontractor organizations. This report of activities on the program is organized in accordance with a work breakdown structure in which projects are organized according to materials research thrust areas. It is the intent of the AR & TD Fossil Energy Materials Program to sponsor materials research which is generic to a number of fossil energy technologies. It is hoped that this series of AR & TD Fossil Energy Materials Program semiannual progress reports will aid in the dissemination of information developed on the program.

44860 **(PB—87-207403/XAB) Chemisorption, reaction, and desorption studies of coal chars in steam, oxygen, and carbon dioxide. Annual report, January-December 1986.** Radovic, L.R.; Lizzio, A.A. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Jan 1987. 56p. NTIS, PC A04/MF A01.

Reactivity profiles for gasification in oxygen and carbon dioxide were obtained as a function of conversion for a bituminous coal char. Thermogravimetric analysis was used under conditions of chemical control. The variation of the oxygen chemisorption capacity of the char with conversion was also measured in the microbalance. The various rate versus conversion plots were discussed in terms of variations of active surface area of the char.

44861 **(PB—87-208708/XAB) Regeneration of refrigerated methanol in conditioning gases from coal. Final report, June 1984-October 1985.** Ferrell, J.K.; Staton, J.S.; Rousseau, R.W.; Carnes, K.J. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Jun 1987. 110p. NTIS, PC A06/MF A01.

The report gives results of an examination of various methods of solvent regeneration in an acid-gas-removal system (AGRS) coupled to a fluidized-bed gasifier. (Research on acid-gas removal using refrigerated methanol had shown that, when a high-purity gas is desired as a product gas, the most critical step in the process is solvent regeneration). The composition of the absorber exit gas stream (the sweet gas) obtained from each system configuration studied was used as a basis for comparing the various schemes. For the systems studied, the ability of the acid-gas-removal system to produce a conditioned gas with low levels of H_2S and CO_2 was found to be governed primarily by the purity of the solvent entering the absorber, and thus by regeneration conditions. These results are believed to be general for refrigerated methanol systems and, together with mathematical models developed as a part of the project, can provide a basis for selecting an optimum configuration for an acid-gas-removal system. The fate of the various trace compounds produced in the gasifier was determined, and a design method for predicting the exit stream in which these compounds leave the AGRS was proposed.

44862 **(SAND—86-2306C) Vapor and liquid phase hydrotreatment of hydropyrolysis tar with hydrous titanium oxide catalysts.** Stephens, H.P.; Bolton, C.; Snape, C.E. (Sandia National Labs., Albuquerque, NM (USA); Coal Research Establishment, Cheltenham (UK)). 1987. Contract AC04-76DP00789. 5p. (CONF-871030—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009541.

From Coal science international conference; Maastricht, Netherlands (26 Oct 1987).

Thermal decomposition of coal under hydrogen pressure (hydropyrolysis) is a possible route to chemical feedstocks and synthetic fuels. Tar yields are significantly higher than those obtained by conventional carbonization. Above about 750°C, primary tars hydrocrack to give appreciable yields of benzene and ethane. Unfortunately, methane yields and, consequently, hydrogen consumptions are also high. However, tar vapors can be catalytically hydrotreated at about 400°C to give distillable liquids. In early studies, the yields were low (<10% daf coal) principally because the reactors were operated at relatively low pressure (<50 bar). Recently, much higher yields of low boiling products (20 to 25% daf coal) with little methane have been obtained in a two-stage fixed-bed reactor operated up to 250 bar and using a commercial Ni-Mo/alumina catalyst. Previous work by one of the authors has demonstrated that hydrous titanium oxide (HTO) exchanged with Pd can hydrogenate polynuclear aromatic compounds at much lower temperatures and pressures than conventional Ni-Mo and Co-Mo on alumina catalysts. In the present study, HTO formulations containing Ni, Co, Mo and Pd have been used to hydrotreat tar produced by hydropyrolysis. Batch liquid-phase hydrotreatment of condensed tar was initially used to compare the activity of the catalysts. Subsequently, the catalysts were employed to hydrotreat tar vapors passed through the catalytic stage of a two-stage hydropyrolysis reactor. The results of these tests with the HTO catalysts are compared to those obtained with a commercial Ni-Mo/alumina catalyst. 9 refs., 1 tab.

44863 (UCRL—97245) Excavation of the Partial Seam CRIP underground coal gasification test site. Cena, R.J.; Britten, J.A.; Thorsness, C.B. (Lawrence Livermore National Lab., CA (USA)). 14 Aug 1987. Contract W-7405-ENG-48. 10p. (CONF-8708106—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014231.

From 13. annual underground coal gasification symposium; Laramie, WY, USA (24 Aug 1987).

In the fall of 1983, Lawrence Livermore National Laboratory conducted the Partial Seam CRIP (PSC) underground coal gasification (UCG) field experiment at the Washington Irrigation and Development Company mine near Centralia, Washington. The test, in the subbituminous Big Dirty coal seam, lasted 30 days during which time 1400 cubic meters of coal were consumed from two injection/production well combinations. In the spring of 1986, normal mining activity in the vicinity of the PSC test allowed the opportunity to carefully excavate the experiment and examine the post-burn cavities. The mining operation dug out the front and back half of the test area and most of the overburden above the UCG cavities, leaving approximately 23,000 cubic meters of earth containing the main portion of the test area undisturbed. Under direction of the Wyoming Research Institute (WRI), this remaining earth was carefully excavated, in slices perpendicular to the original injection/production line, using small earthmoving equipment to uncover and sample the final burn cavities. Preliminary results of the excavation were presented by WRI at the 12th Underground Coal Conversion Symposium. We present additional results and conclusions based on all of the information obtained. Topics covered include: comparison to material balance and thermal instrumentation data, analysis and composition of samples taken from the cavity and general cavity shape and characteristics in comparison with mechanistic models of cavity growth. 10 refs., 10 figs., 1 tab.

44864 (ECE—EB.AIR/SEM.1/R.30) Environmental aspects of coal liquefaction and heavy oil upgrading. Graeser, U.; Merz, L. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 8p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The upgrading of fossil energy sources such as coal and heavy oil/bitumen by hydrogenation leads to the reduction of sulfur and nitrogen to H_2S and NH_3. This is therefore a way of reducing sulfur dioxide and nitrogen oxides emission as more than 98% of H_2S can be converted into elemental sulfur by standard refinery technology and NH_3 can be removed as a final product. The hydrogenation technology for high sulfur heavy oil/bitumen converts the feedstock to an extent of 90% or more into light distillates and gases with only small amounts of hydrogenation residue. Coal can be directly liquefied via a hydrogenation process with end products with sulfur and nitrogen contents of less than 10 ppm obtained. The liquid products may be used as fuel for vehicles and heating. Some 35-40% of the feed coal remains as hydrogenation residue. The overall sulfur balance for a coal hydrogenation plant thus depends on the feed coal and the use of hydrogenation residues: gasification, combustion and blending into coking coal can also be applied.

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REFER ALSO TO CITATION(S) 44832, 44854, 44857, 44932, 45315, 45877

44865 (ACIRL-PR—87-1) Applied coal and coke petrography in ACIRL. Ng, N.; Cudmore, J.F. (Australian Coal Industry Research Labs. Ltd., North Ryde). 1987. 68p. Australian Coal Industry Research Laboratories.

ACIRL introduced petrography into its range of services in the early 1970s because of anticipated benefits it offered in characterising coking coals and in providing technical support for Australia's expanding export market for metallurgical coal. In addition, petrography was being accepted and used internationally for coal characterisation. Besides employing expert petrographers for establishing this specialist area of coal science, ACIRL became actively involved in the activities of the International Committee for Coal Petrology (ICCP) and currently maintains this involvement through its Senior Petrographer. Whilst petrography was introduced to characterise coking coals, its use has been extended over the past decade to include the characterisation of coals for other utilisation processes, e.g., combustion, liquefaction, gasification, and to assist in solving practical problems in mining, handling and beneficiation of coals. The report reviews basic petrographic terminology and application of the science to exploration, mining, handling, beneficiation and utilisation of coal.

44866 (CONF-871030—3) Directions of research from the Argonne Premium Coal Sample Program. Vorres, K.S. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 3p. NTIS, PC A02. File Number DE87011366.

From Coal science international conference; Maastricht, Netherlands (26 Oct 1987).

The Premium Coal Sample Program at Argonne National Laboratory is intended to provide the basic coal science community with a set of eight coal samples. These samples have been carefully selected, collected, transported, processed, packaged, characterized and are being distributed. The collection and processing have been carried out in a manner planned to provide samples that are as close to the pristine coal in the seams as possible. The need for a collection of coal samples of this type has been expressed repeatedly. Controversy in the literature and various forums has been unresolved due to the uncertainty of the potential oxidation or change of samples, or the difference in samples collected from the same seams. The results of the work are beginning to appear in the literature. They indicate that the samples have had minimal exposure to oxygen as shown by a variety of studies including solvent extraction and observation of elemental sulfur with oxidized but not premium samples. 1 tab.

44867 (CONF-871030—5-Summ.) Structural information from the selective methylation of acidic O-H and C-H sites in coal. Chambers, R.R. Jr.; Hagaman, E.W.; Woody, M.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. File Number DE87012248.

From Coal science international conference; Maastricht, Netherlands (26 Oct 1987).

Recently, it has been shown by us and others that a detailed description of coal structure and reactivity can be achieved by the application of techniques which include selective chemical modification and NMR spectroscopy. Due to the structural complexity of coal, it has become apparent that the structural conclusions derived independently from a chemical or spectroscopic analysis are placed

on a more sound chemical basis when the two techniques are used in conjunction with one another. Here we illustrate this principle using a vitrinite-rich, low volatile bituminous coal, PSOC 1197, which has the empirical formula $C_{100}H_{64}N/sub\ 1.5/S/sub\ 0.5/O_9$. Studies from the application of this approach to one of the Argonne Premium coal samples are in progress. 12 refs.

44868 (DOE/FE/60177—2305-Vol.1, pp 252-255) **Impacts of porphyrins.** Branthaver, J.F. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Metalloporphyrins and other metal chelates are naturally occurring constituents of fossil fuels. These compounds have deleterious effects on the processing of fossil fuels. They are also useful biomarkers in geochemical exploration, and have environmental impacts. Heavy oils, tar sands, shale oils, and coal liquids often contain significant concentrations of these compounds. Most review articles published in this area concentrate on geochemical studies or processing studies. Investigators in one of these fields are usually not aware of development in the other. No up-to-date comprehensive overview of the subject of metal chelates in fossil fuel existed. Consequently, there was a need for a general literature survey of the subject of metal chelates in fossil fuels. One objective of the work was to survey the literature on the subject of metal chelates in fossil fuels. Another objective was to use the literature search to prepare overview articles on the geochemical and processing aspects of metal complexes in fossil fuels. A third objective was to develop research recommendations in the study area that might be supported by the US Department of Energy.

44869 (DOE/PC/70795—T8) **The macromolecular chemistry of coalification: Quarterly report for the period May 1, 1987-July 31, 1987.** Larsen, J.W.; Kovac, J. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry; Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 26 Aug 1987. Contract FG22-84PC70795. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013930.

A molecular level explanation for the dilatometric behavior of an hvAb coal is sought. The macromolecular network structure of bituminous coals is described with emphasis on the non-covalent interactions responsible for coals being glasses at room temperature. The existence of a glass to rubber transition in coals at 600°K detected by both DSC and NMR is described and related to the initial softening and contraction observed in the dilatometer. The relationship between the phase transition and the pyrolysis chemistry simultaneously occurring is discussed and it is concluded that it is not known whether covalent bond cleavage is a cause of the phase transition. Covalent bond cleavages are not necessary for the transition to occur. In coking coals, thermally induced cross linking begins at temperatures well above T/sub g/ and after most tars have been released from the coal. The high degree of structural anisotropy of all coals is revealed by solvent swelling. Its role in coke forming processes is unknown. 23 refs.

44870 (DOE/PC/70798—T10) **Weathering effects on structure and reactivity of US coals: Third quarterly report.** Meuzelaar, H.L.C.; Hill, G.R.; Yun, Yongseung; Jakab, E. (Utah Univ., Salt Lake City (USA)). [1987]. Contract FG22-84PC70798. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013763.

The temperature of maximum rate of weight loss in thermal gravimetric analysis occurs at 520°C for Upper Freeport coal (mvb) and at 470°C for Anderson coal (subbituminous C). The maximum rate of weight loss decreases significantly with the degree of weathering. This trend appears to be due to two separate weathering effects: (1) a decreased total volatile matter yield, consequently an increased char yield, and (2) a broader distribution of activation energy in weathered coal. Evolution profiles on each mass with temperature show the dramatic effect of weathering, confirming that kinetics in devolatilization and pyrolysis between fresh and weathered coals are quite different. Especially, evolution profile of carbon dioxide (m/z 44) shows the significant formation of carboxylic functional groups as weathering proceeds. TG/MS analysis shows that both aromatic and aliphatic moieties in coal decreases with the degree of weathering. This trend was more profound in Upper Freeport coal (mbv) than Anderson coal (subbituminous). The TG/MS technique is a valuable tool for investigating the kinetics of coal pyrolysis and combustion. More elaborate TG/MS studies are needed to examine the effect of weathering on kinetics and, thus, to determine the effect on variables in the real processes, such as combustion, liquefaction and gasification. This kind of study will give the sufficient information for the prevention of energy loss during coal usage from weathering. 13 refs., 9 figs., 1 tab.

44871 (DOE/PC/80519—7) **Diffusion of gases in coals and chars: Quarterly technical progress report No. 7, March 15, 1987-June 14, 1987.** Smith, D.M. (New Mexico Univ., Albuquerque (USA). Powders and Granular Materials Lab.). 1987. Contract FG22-85PC80519. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014634.

The operational problems with the pellet string reactor apparatus for measuring effective diffusivities in coal have finally been rectified. A series of runs using solid packing in the column have been completed to validate the system and data analysis. With the pellet string reactor, a number of transport parameters are determined from the same experiment. These include the mean gas velocity, dispersion coefficient, adsorption coefficient, and effective diffusivity. By using a solid packing with a tracer which does appreciably adsorb at the measurement temperature and pressure, the shape the elution curve (i.e., concentration versus time) at the column exit is a function of the carrier gas flow rate and the dispersion coefficient only. Figure 3 contains elution curves for three different flow rates for methane tracer in a helium carrier stream at $\approx$295 K and 0.83 atm. The magnitude of the dispersion coefficient has been determined as a function of the particle Reynolds number. At low Reynolds number ($Re < \approx 0.1$), dispersion is dominated by molecular diffusion and the dispersion coefficient is independent of flow rate (Re). At higher flow rates (Re), turbulence becomes important. This transition between molecular diffusion and turbulence depends upon the surface roughness of the particles. Figure 5 demonstrates the same effect except that the results are presented in terms of the two dimensionless groups, the Peclet number and the Reynolds number. In the molecular diffusion regime, the tortuosity of the column may be determined from the ratio of the dispersion coefficient to the molecular diffusion coefficient for methane in helium. For the glass bead column, the tortuosity was 0.799 and 0.786 for the steel shot packed column. These results are in excellent agreement with previously published results for packed beds. 5 figs.

44872 (DOE/PC/80521—T8) **Acid-base properties of coals and other solids: Final report, September 1, 1985 to August 30, 1987.** Arnett, E.M. (Duke Univ., Durham, NC (USA). Dept. of Chemistry). 1987. Contract FG22-85PC80521. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014206.

A thermodynamic approach using several calorimetric and chromatographic method was developed for comparing the effective acid strengths of solids with each other and with homogeneous analogues. For example, the heats of reaction of solid sulfonic acid resins with a series of over twenty nitrogen bases were correlated exactly with the corresponding heats of reaction of the same bases with p-toluenesulfonic acid solutions. The excellent correlations between heats of reaction of twenty-odd bases with Dowex and Nafion acid resins and with solutions of p-toluenesulfonic acid may be regarded as a limiting case where proton transfer and ion-pairing completely overwhelm all other interactions between the liquid base solutions and the solid phase. At the other limit, one may regard the interactions of the same bases with carbonaceous solids as involving dispersion, dipole-induced dipole, etc., which often are lumped under physisorption. Such interactions are thermochemically significant and must contribute in varying degrees to the adsorption of any gas or liquid on any solid. 5 refs., 1 fig.

44873 (DOE/PC/80911—T7) Linkages and aromatic clusters in a bituminous coal: Quarterly technical progress report No. 7 for the period March 1, 1987-May 31, 1987. Chung, K.E. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). 1987. Contract FG22-85PC80911. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014426.

The objectives of this investigation are: (1) quantitative characterization of a bituminous coal in terms of its major composition and molecular structural characteristics; and (2) a specific examination of aliphatic linkages of the coal. The characterization methodology consists of a controlled depolymerization of a sample coal, solvent extraction of the product, and detailed analysis of the product fractions. For the specific examination of aliphatic linkages, well-characterized soluble fractions from the same coal are investigated by a transalkylation reaction. Major results previously presented include the chemical structural characterization of an Illinois No. 6 bituminous coal in terms of aromatic clusters, linkages, side chains and oxygen functional groups. Based on these data, a molecular model of the Illinois coal was constructed, and product distribution and a minimum hydrogen requirement in the hydroliquefaction of the coal were predicted. During the solubilization reactions with NaOH/ethanol/H_2O, ether groups of the coal were hydrolyzed at 260 to 300°C, and phenolic rings in aromatic clusters were hydrolyzed and opened extensively at 300 to 320°C, leading to the cleavage of aliphatic linkages. Transalkylation reactions of three soluble fractions from the characterization work resulted in high yields of toluene derivatives. The yields of toluene derivatives from two feed fractions were similar, but much higher than that from the other fraction. Field ionization mass spectroscopy (FIMS) of toluene derivatives from the two feed fractions showed high concentrations of toluene derivatives containing $-CH_2-$ and $-CH_2-CH_2-$ linkages. 1 ref., 1 tab.

44874 (DOE/PC/90529—3) Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 March 1987-15 June 1987. Calo, J.M.; Perkins, M.T.; Lilly, W.D. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1987. Contract FG22-86PC90529. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013664.

In this third quarterly technical progress report, we present some initial data obtained with the "gradientless" reactor, and explore the effects of dispersion in the reactor sampling line. In particular: the gas sampling system and the solenoid valve network have been assembled and interfaced between the 3" Berty catalytic reactor and the mass spectrometer beam system; initial purging experiments were conducted with this system, focusing on the convoluting effects of the sampling line on time constant measurements; it was shown and concluded that for the projected operating regime, the sampling line configuration without the in-line filter should not introduce any appreciable error in the measurements; and an analysis of the dispersion effects to be expected in the sampling line has defined the useful flow rate ranges for the current system and the means by which to extend the dynamic range; e.g., by increasing the length of the small bore diameter tubing. 21 refs., 11 figs.

44875 (EPRI-AP—5394) Rheology of coal-water slurries at elevated temperatures for gasification: Final report. Potas, T.A.; DeWall, R.A.; Maas, D.J. (North Dakota Univ., Grand Forks (USA). Energy Research Center; Electric Power Research Inst.. Palo Alto, CA (USA)). Aug 1987. 23p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920575.

Laboratory-scale studies were conducted to investigate the benefits of temperature on the rheological properties of coal/water fuels (CWF) prepared for gasification. A variety of feedstocks were studied, including a lignitic, a subbituminous, and two bituminous coals. The lignitic and subbituminous coals had been hydrothermally treated to increase their potential for highly concentrated CWF preparation. One widely available dispersant to increase solids concentrations, ammonium ligno-sulfonate (ALS), was also tested for performance and temperature dependence. Logarithmic decreases in viscosity occurred for the CWFs tested over the temperature range studied, although the viscosity decrease was greater for the CWFs made from the hydrothermally treated low-rank coals. Solids contents were increased and viscosities were reduced for the CWFs with the addition of ALS dispersant. Also, the dispersant was not adversely affected by the increased temperature, as the viscosity reductions of the CWF with ALS paralleled the reductions for CWF without ALS. Additionally, yield stress of the CWF prepared with the bituminous coals was substantially reduced by the ALS dispersant. 8 refs., 7 figs., 3 tabs.

44876 (ERP/CRL—86-115(TR)) Computer program to calculate the rank of a coal. Corbett, G.R.; Bonnell, G.W. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Oct 1986. 15p. CANMET.

The computer program RANK.BAS was written for use on an IBM-PC/AT or compatible microcomputer. It was developed to provide coal classification according to rank using American Society for Testing and Materials method D388-84. 2 refs.

44877 (NERDDP-EG—85-392) Determination of trace elements in coal and coal products - part 5. Characterisation of a range of Australian raw coals. Knott, A.C.; Warbrooke, P. (Broken Hill Proprietary Co. Ltd., Shortland (Australia). Central Research Labs.). 1983. 65p. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

Twenty seven coals from NSW, Queensland, Western Australia, South Australia and Tasmania were obtained from interested companies and organisations. Full ultimate analyses including oxygen, mineral matter and combined water are reported. Elemental analysis of the mineral matters, comprehensive (about 40) trace elements, quantitative x-ray diffraction analysis of minerals present and carbonisation and petrographic analyses are detailed. Results obtained for the Australian raw coals are compared with overseas coals data. The information contained in this report comprises the most comprehensive characterisation data reported on a series of Australian coals. 36 refs.

44878 (PB—87-213146/XAB) Electron-transfer reactions in coal model compounds. Annual report, January-December 1986. Penn, J.H. (West Virginia Univ., Morgantown (USA). Dept. of Chemistry). Mar 1987. 27p. NTIS, PC A03/MF A01.

Through the use of a unique one-electron outer-sphere oxidant (i.e., $Fe(1,10\text{-phen})_3(PF_6)_3$), conditions were determined that will allow the determination of electron transfer rates from compounds containing aryl-alkyl interconnecting bonds. An unusually low activation energy for the electron transfer was determined for bicumyl. This unusually low activation energy implies that radical-cation formation may proceed more readily than previously thought. Both intramolecular mechanisms and intermolecular mechanisms are postulated to be operative in coal materials.

44879 (UCRL—97256) Coal reactivity measurements. Kang, S.W.; Bedford, R.; Curry, K.; Britten, J. (Lawrence Livermore National Lab., CA (USA); Prairie View A and M Univ., TX (USA)). 10 Aug 1987. Contract W-7405-ENG-48. 7p. (CONF-8708106—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014230.

From 13. annual underground coal gasification symposium; Laramie, WY, USA (24 Aug 1987).

Measurements have been made of reaction rates of coals and coal chars with reacting gases present in the underground coal gasification processes. Thermogravimetric analysis (TGA) was employed for this purpose. Results show that char-CO_2 reaction becomes significant at about 650°C, and that the activation energy for this reaction is approximately 40 kcal/mole for Wyodak coal. 6 refs., 6 figs.

44880 Low-voltage, high-resolution mass spectrometric methods for fuel analysis: application to coal distillates. Schmidt, C.E.; Sprecher, R.F.; Batts, B.D. (Pittsburgh Energy Technology Center, PA). *Analytical Chemistry;* **59**: No. 17, 2027-2033(1 Sep 1987).

A low-voltage, high-resolution mass spectrometric (LVHRMS) method for analyses of complex materials, such as

coal-derived liquids, is presented. Descriptions of the computations utilized to convert LVHRMS spectra to weight percent data on individual compound types and the associated computer software are reported. Elemental analyses, carbon number distributions, number average molecular weights, and a measure of aromaticity have been determined for 10 distillate fractions derived from an H-Coal liquid by this technique, and the results were compared with those obtained by classical methods. The changes in distribution of the principal compound classes over the range of distillates can readily be followed. The LVHRMS method described can be applied to other complex materials containing heteroatoms.

44881 **Polarizability of coal liquefaction product distillates.** White, C.M.; Schmidt, C.E. (USDOE Pittsburgh Energy Technology Center, PA. Division of Coal Science). *Fuel;* **66**: No. 8, 1030-1035(Aug 1987).

A purpose of this investigation is to gain insight into the intermolecular forces present in coal liquefaction products. The mid-boiling point of distillates from coal liquefaction products reflects the intermolecular forces present. The mid-boiling point of distillates from H-Coal and Wilsonville products is a linear function of their average molar volume and average molar polarizability, which are directly related to van der Waals forces. The results presented here support, but do not prove, the conclusion that van der Waals forces are the dominant intermolecular forces in the H-Coal and Wilsonville distillates. 38 refs., 2 figs., 3 tabs.

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REFER ALSO TO CITATION(S) 44816, 44958, 44959, 45322, 45323, 45324, 45583, 45961, 46164

44882 **(CRIEPI—218) Study on NO removal in combustion flue gas by ammonia gas injection.** Sato, M. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1986. vp. (In Japanese). Central Research Institute of Electric Power Industry.

NH_3 gas is injected into flue gas, decomposes NO/sub x/ selectively with noncatalytic conditions under the presence of oxygen and high temperature (900 C and 1100 C). The mechanism of noncatalytic NO/sub x/ removal by ammonia gas injection has been studied with experiments and a chemical kinetics model. The experimental results were obtained using the combustion research facility. In the chemical reaction model, thirty nine elemental reactions and fifteen chemical species were used. Main results were as follows: (1) the optimum temperature in the noncatalytic NO/sub x/ process by ammonia gas injection, was about 1050 C; 2) the optimum temperature for NO/sub x/ removal efficiency decreased with the injection of H_2 gas mixed with NH_3 gas; (3) a full chemical kinetics calculation gave good agreement with experimental results; and (4) by a theoretical calculation, it was clarified that NH_2 species had an important role in NO removal process by NH_3 decomposition.

44883 **(CRIEPI—285078) Making coal ash fertilizer combined with phosphoric acid solutions (Part 1).** Arai, T. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1986. vp. (In Japanese). Central Research Institute of Electric Power Industry.

This report aims to clarify the possibility of shellfish as a component of a coal ash fertilizer which is currently being developed. New combined fertilizers were produced by adding and mixing a wet or dry powdered shellfish in coal ash-phosphoric acid coagulants. The fertilizer showed good fertilizer characteristics on solubility, hardness and wettability compared with a reference fertilizer. Moreover, in fertilization tests with new combined fertilizers to some green vegetables, the yield of these specimens was about 10% more than the yield by the reference fertilizer.

44884 **(DOE/PC/80520—T8) Studies on the reaction of calcined limestone with sulfur dioxide: Technical progress report for the period April-June 1987.** Sotirchos, S.V. (Rochester Univ., NY (USA). Dept. of Chemical Engineering). Jul 1987. Contract FG22-85PC80520. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013519.

This quarterly report presents technical progress achieved during the second calendar quarter of 1987 on the investigation of the reaction of calcined limestone with sulfur dioxide. The report is divided into two main parts. In the first part, a statement of work proposed to be carried out under this project is given and the various tasks associated with the project are identified and outlined. In the second part, the work carried out during the above-mentioned period is described.

44885 **(EPRI-CS—5312) Calcium spray dryer waste management: Design guidelines: Final report.** (ICF Northwest, Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 545p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920589.

Calcium spray drying is a commercially available and applied technology used to control SO_2 emissions. This process is rapidly gaining utility acceptance. Because physical and chemical properties of wastes generated by calcium spray drying differ from those of conventional coal combustion by-products (fly ash and scrubber sludge) typical waste management practices may need to be altered. This report presents technical guidelines for designing and operating a calcium spray drying waste management system. Waste transfer, storage, pretreatment/conditioning, transport and disposal are addressed. The report briefly describes eighteen existing or planned calcium spray drying waste management systems. Results of waste property tests conducted as part of this study, and test data from other studies are reported and compared. Conceptual designs of both new and retrofit calcium spray drying waste management systems also are presented to demonstrate the economic impact of spray drying on waste management. Parametric cost sensitivity analyses illustrate the impact of significant design parameters on waste management costs. Existing calcium spray drying waste management experiences, as well as spray drying waste property data provided the basis for guideline development. Because existing calcium spray drying facilities burn low sulfur coal, this report is considered applicable only to calcium spray drying wastes produced from low sulfur coal. At this time, calcium spray drying is not expected to be feasible for high sulfur coal applications.

44886 **(EPRI-CS—5355) Evaluation of the toxicity characteristic leaching procedure (TCLP) on utility wastes: Final report.** Jackson, L.P.; Sorini, S. (Western Research Inst., Laramie, WY (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 96p. RRC, Box 50490, Palo Alto, CA 94303. File Number TI87920555.

Forty-one utility wastes from conventional and advanced SO_2 control technologies were studied to compare the performance of the wastes under EPA's new toxicity tests. The study addressed three aspects of the new test: (1) The effect of increasing the filter pore size from 0.45 microns in the EPTC to 0.7 microns in the TCLP. This change has the potential to impact the results obtained on fine grained wastes like SO_2 control residues if it will allow small sized particles to pass through the filter and contribute to the final concentration of inorganic elements measured in the leachate. (2) The effect of changing the chemical nature of the leach medium on the measured values of the inorganic analytes in the leachates. The TCLP data were compared to previously measured EPTC data and data obtained from leaching the wastes with distilled-deionized water by the ASTM D 3987 test procedure. (3) The levels of organic compounds found in TCLP leachates from coal combustion residues.

44887 **(EPRI-EA—5176-Vol.1) Inorganic and organic constituents in fossil fuel combustion residues: Volume 1, A critical review.** Rai, D. (Pacific Northwest Lab., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. Contract AC06-76RL01830. 362p. NTIS, PC A16/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87013857.

The literature on selected inorganic and organic constituents of fly ash, bottom ash, flue gas desulfurization (FGD) sludge, and oil ash was reviewed to summarize the available data on the concentrations and leachability of 28 selected elements in the wastes

and to determine the availability of mechanistic data for describing the leachability of the elements. The data summarized and critiqued for each of the 28 elements included (1) the content of the element in the wastes, (2) the relative distribution of the element in different particle size fractions and at the surface or interior of the waste particles, (3) the predicted and observed solid phases of the element, (4) the leachability of the element in different solutions, (5) fundamental reactions of the element in fossil fuel wastes, and (6) thermochemical and geochemical data for the element that are applicable to fossil fuel wastes.

44888 **(EPRI-EA—5176-Vol.2) Inorganic and organic constituents in fossil fuel combustion residues: Volume 2, An annotated bibliography.** Rai, D. (Pacific Northwest Lab., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. Contract AC06-76RL01830. 90p. NTIS, PC A05/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87013684.

An annotated bibliography of the literature pertaining to the chemical behavior of inorganic and organic constituents present in fossil fuel wastes [fly ash, bottom ash, flue gas desulfurization (FGD) sludge, and oil ash] is presented in this report. The steps taken to produce the bibliography included (1) collecting a complete set of articles through computer searches of major databases, physical searches of articles published during the last five years in about 50 journals, and searches of references quoted in symposium proceedings and review articles; and (2) classifying the articles by subject categories. The categories were selected as being conducive to determining the availability of mechanistic data needed to predict the geochemical behavior of waste constituents. References relating to inorganic constituents are listed alphabetically, with each reference followed by the assigned subject categories. References relating to organic constituents follow in a separate section. For easy access, all references for a given subject category are cross-indexed, and the indexes for the inorganics and organics sections are given at the end of the volume. The annotated bibliography was important in organizing the literature for a critical review, which is the subject matter of Volume 1 of this report. The annotated bibliography also provides (1) a reference volume on the available literature for the chemical behavior of constituents present in fossil fuel wastes, and (2) ready access to the literature on subject areas and constituents not considered in the critical review.

44889 **(ERP/ERL—86-34(TR)) Evaluation of the uses and morphology of atmospheric fluidized bed combustion wastes from CFB Summerside AFBC boilers.** Berry, E.E.; Anthony, E.J.; Kalmanovitch, D.P. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Sep 1985. 43p. CANMET.

The object of this study was to examine and identify potential uses for solid wastes from atmospheric fluidized bed combustion (AFBC) boilers. A literature search was conducted to identify potential applications for AFBC residues and the nature of the residues was examined by scanning electron microscopy, electron microprobe and chemical and physical tests. Promising areas of use identified included: agriculture, pollution control, soil stabilization, asphaltic concrete aggregate and low strength backfill applications. 32 refs.

44890 **(PB—87-203170/XAB) Evaluation of sorbents and additives for dry SO_2 (sulfur dioxide) removal (journal version).** Jorgensen, C.; Chang, J.C.S.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC (USA)). 1987. 10p. NTIS, PC A02/MF A01.

Pub. in Environmental Progress, Vol. 6, No. 2, 26-32(Feb 1987); See also PB—86-160272.

The paper gives results of bench-scale reactivity studies of alkaline sorbents, performed in an integrated fixed-bed reactor, simulating the fabric-filter dust layer of dry flue-gas desulfurization (FGD) systems. Relative humidity significantly affected SO_2 absorption by lime and limestone plus additives such as $CaCl_2$, $Ca(NO_3)_2$, and $NaNO_3$, but had less impact on $NaHCO_3$ reactivity. Different reaction patterns of various sorbents were observed. Results are discussed relating to sorbent screening for dry FGD systems.

44891 **(PBE—12598-9002) Emission reduction and cogeneration.** Sanden, A.M. van der; Heidweiller, D.J. (TEBODIN, Advies- en Constructiebureau B.V., The Hague (Netherlands)). 1985. 160p. (In Dutch). Tebodin Raadgevende Ingenieurs, The Hague, Netherlands.

Dual-purpose power plants have certain advantages. They reduce both energy generation and the environmental burden of waste heat. Reduction of emission of combustion products, soot and fly ash is the subject of this study. This may be reached by: the use of clean(ed) fuels, cleaning of flue gases, and prevention of the formation of undesired products as nitrogen oxides, carbon monoxide, soot and PAHs. The last two methods are discussed. Sulfur dioxide may be removed by wet or dry gas scrubbing or by the Shell CuO-process. Nitrogen oxide emission may be reduced by prevention of NO/sub x/ formation or by catalytic reduction of the stack gas. Investments are always necessary for stack gas cleaning. Fluidized bed combustion and especially multi stage bed combustion are promising techniques for the application of several processes for stack gas cleaning.

44892 **(ECE—EB.AIR/SEM.1/R.9) Utilization of by-products from the gypsum process and spray absorption process.** Lyngrig, Y. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 6p. (CONF-8605284—Summ.). Government of Denmark.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

In 1984 legislation on the reduction of sulfur dioxide emissions from coal-fired power plants passed the Danish parliament. The Danish Minister for the Environment appointed a committee which was entrusted with the evaluation of the potential use of by-products from the two most typical desulfurization technologies: the gypsum process and the spray absorption process. Responsibility for this work was given to the National Agency for the Protection of Nature, Monuments and Sites whereas the work on potential use of by-products was carried out by research institutes. The potential utilization of by-products is concentrated on the cement industry, road construction, plaster board production and the production of dicalcium sulphate. The paper describes the technical and economic possibilities of the utilization of by-products from the gypsum and the spray absorption process within the above mentioned industries.

44893 **(ECE—EB.AIR/SEM.1/R.13) Marketing and dump storing of solid end-products of a flue-gas desulphurization plant.** Heikkila, M.; Sundberg, L.; Taipale, L. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 6p. (CONF-8605284—Summ.). Government of Finland.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Finland has targeted to reduce annual sulfur emissions by 30% by 1993 and the first desulfurization plant will be built for the Salmisaari power stations of the Helsinki Energy Board. The process chosen for these power stations was from three possible alternatives: a wet lime scrubbing system, a half-dry lime spraying system and a system combining dry and half-dry systems. The possibilities of utilizing the solid end-products of flue gas desulfurization have not yet been studied in detail and the construction industry has imposed such high quality requirements on flue-gas gypsum that so far they cannot be fulfilled economically. At present the most profitable use for the calcium sulfite is to use it for lining dumping areas. Research work is underway on improving the utilization of end-products.

44894 **(ECE—EB.AIR/SEM.1/R.16) Reduction of SO_2 and NO/sub x/ emissions from stationary sources in North Rhine-Westphalia - strategy and results.** Puetz, M.; Bartholot, H.D. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 9p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

In North Rhine-Westphalia (NRW), the coal area of the Federal Republic of Germany, the main sources of sulfur dioxide and nitrogen oxides emissions are coal-fired power stations. In its

policy of air pollution control NRW has recognised this. For hard coal fired power stations it issued the Ordinance for the Desulfurization of Flue Gas to reduce the emission of sulfur dioxide pollutants. In 1984 the Emission Reduction Plan laid down a comprehensive concept for the reorganization of power plants that are part of public energy utilities and aimed at a further reduction of their emissions of sulfur dioxide and nitrogen oxides. The plan covers 71 power plants with a thermal output of about 83,000 MW. The voluntary commitment of the operators will reduce sulfur dioxide emissions by four-fifths up to 1994 and nitrogen oxides emissions by almost three-quarters up to 1990. The paper also considers the problems of disposal of residual pollutants and the state-of-the-art concerning the reduction of sulfur dioxide and nitrogen oxides emissions from power station plants in NRW as well as the costs involved.

44895 **(ECE—EB.AIR/SEM.1/R.20) Flue gas desulphurization by lime/limestone processes in the Federal Republic of Germany.** Bosselmann, W. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 10p. (CONF-8605284—Summ.). Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Since 1976, flue gas desulfurization plants have been operated on a commercial scale in power stations in the Federal Republic of Germany. They are mostly lime/limestone processes which have been modified and optimized. Results of development are described in the paper, giving selected examples of simplification and compact layout which decreases both investment costs and energy consumption. Overall efficiency could be increased so that even coal with high sulfur content can be used without exceeding the maximum allowable sulfur dioxide concentration in flue gas. The gypsum produced can be modified for later use. Flue gas desulfurization plants now in operation and those to be constructed will have an equivalent capacity of about 36,000 MWe, 90% of which will be based on lime/limestone processes. It is expected that the sulfur dioxide emission of power stations in the Federal Republic of Germany will drop from about 1.7 million tons per annum in 1979 to less than 50,000 tons per annum in 1995. A considerable contribution to the decrease of SO_2 emission is attributable to use of nuclear energy.

44896 **(ECE—EB.AIR/SEM.1/R.22) Costs and effectiveness of reducing sulphur and nitrogen emissions from power plants in Baden-Wuerttemberg.** Voss, A. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 8p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

In 1983/84 the state government of Baden-Wurttemberg in the Federal Republic of Germany set up two commissions to investigate an optimal control strategy for the reduction of sulfur dioxide and nitrogen oxides emissions from public power plants. A comprehensive cost effectiveness analysis was carried out in order to identify optimal control strategies. A reduction of both sulfur dioxide and nitrogen oxides emissions to about 25% of present levels is achievable by the end of the decade if cost-effective measures can be realised. The control strategy will require an investment of 1.75 billion DM by the electric utilities and the cost of electricity consumer prices will rise. 3 refs.

44897 **(ECE—EB.AIR/SEM.1/R.25) Cost of flue gas desulphurization and denitrification in the Federal Republic of Germany.** Schaerer, B.; Haug, N. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 20p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The Ordinance on Large Furnaces, under the Federal Clean Air Act of 1983 in the Federal Republic of Germany, requires the retrofitting of existing power plants and other large furnaces in order to reduce sulfur dioxide and nitrogen oxides pollution by 70 to 80% before the 1990s. This requires investment of several billion Deutschmark. The paper describes the cost of the most important processes of emission reduction. The purpose of this analysis is an ascertainment of the total volume of investment required and of the average additional costs of electricity production. Data are also provided for management decisions. The basis of the analysis of costs are flue gas purification plants which represent the present state of control technology. Topics covered are: analysis of the investment capital; discussion of categories of costs, including fixed costs; sorption agents, catalysts, ammonia and energy consumption; and concluding calculation of costs.

44898 **(ECE—EB.AIR/SEM.1/R.27) Processing and utilization of FGD-residuals from coal-fired power plants.** Wirsching, F. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 8p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The paper describes the desulfurization processes used most frequently in coal-fired power stations of the Federal Republic of Germany. These are: wet scrubbing process, dry additive process and spray absorption process. The paper also describes the processing of flue gas gypsum by drying and briquetting methods for subsequent utilization by the gypsum and cement industries, the processing of dry additive waste material into a product suitable for landfill purposes, and the processing of the wastes derived from spray absorption by treatment with pozzolanic reacting fly ash to obtain a commercially reusable material serving as a landfill material or mineral aggregate.

44899 **(ECE—EB.AIR/SEM.1/R.34) Furnace injection of additives for SO_2 reduction.** Chughtai, Y. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 17p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

One possible method of sulfur removal is direct desulfurization - sulfur capture within the boiler. Sulfur capture can be increased by the injection of suitable additives such as calcium carbonates, calcium carbonates and calcium and magnesium hydroxide complexes. Certain conditions must be met to ensure that the desulfurization process can take place. These concern the reaction temperature and residence time as well as the additive injection location. Additive consumption and disposal of the ash represent the greatest share of the operation costs but there is potential for ash reutilization. The economic advantages of direct desulfurization increase as the sulfur content of the coal and the size of the plant decrease. The process is of particular relevance to older power stations where it is impossible to install flue gas desulfurization equipment but retrofitting is relatively easy.

44900 **(ECE—EB.AIR/SEM.1/R.38) Thermal oxidation of spray dryer FGD waste product.** Bengtsson, S.; Aahman, S. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 17p. (CONF-8605284—Summ.). Government of Sweden.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Spray dryer flue gas desulfurization for coal-fired boilers using coals with low and medium sulfur content has become an important technology. However, typically the end-product has been disposed of untreated in landfill areas. In some European countries the end-product must be reclaimed for another use. To meet this requirement the Swedish company Flakt agreed with the American Company Dorr-Oliver to develop a thermal oxidation system based on the Dorr-Oliver Fluosolids Technology. This system calcinates the dry flue gas desulfurization product to produce a technical grade anhydrocabon calcium sulphate which can be used as a setting retarder for Portland cement. The paper describes the process and presents operating experience and test results from pilot and demonstration plant programs. A description is included on how the process has been integrated into a commercial spray dryer FGD system recently sold by Flakt in the Federal Republic of Germany. Topics are covered under the following headings: the national FGD market; technical grade anhydrite usage; process chem-

istry; thermal oxidation; pilot plant work; process description; and first commercial installation. 4 refs.

44901 **(ECE—EB.AIR/SEM.1/R.46) Utilization of residues of desulphurization and denitrification technologies.** Pietrzeniuk, H. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 9p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Large-scale desulfurization plants presently in use in the Federal Republic of Germany produce gypsum, sulfur, sulfur dioxide, sulfuric acid and ammonium sulfate as well as sulfate/sulfite mixtures as residues from dry/quasi-dry processes. Utilization of residues from dry/quasi-dry pollution abatement facilities requires additional treatment processes which involve further costs. The conditions for an orderly and environmentally sound disposal of such residues are described in the paper. Wet processes generate products which can be further utilized. Since gypsum is the largest proportion produced, its market possibilities are discussed in some detail. The total volume of gypsum obtained through desulfurization technologies can be primarily absorbed by the building industry. At present elemental sulfur, sulfur dioxide and sulfuric acid are easily marketed, however the share of sulfur as an unavoidable by-product of other processes will increase and the demand is stagnating as a consequence of utilization processes and avoidance strategies. Product prices for ammonium sulfate are stagnating also. The denitrification process of selective catalytic reduction does not produce any residues.

44902 **(ECE—EB.AIR/SEM.1/R.50) NO/sub x/ control in the United Kingdom - constraints and options in the power generating industry.** Burdett, N.; Lawn, C.; Clapp, R. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 11p. (CONF-8605284—Summ.). Government of the United Kingdom.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Considerable attention has recently been focused on techniques for reducing NO/sub x/ emissions from fossil-fuelled boilers. Current estimates suggest that NO/sub x/ emissions from the United Kingdom power generating industry are dominated by those from coal-fired 500 and 660 MWe boilers and therefore technologies for NO/sub x/ control must be proven at large scale. There are two main categories of applicable emission reduction techniques - the alteration of combustion conditions and the post-combustion methods using ammonia. The latter method is less cost-effective. The work described in the paper has been directed towards investigating the economic and engineering implications of combustion modifications. Criteria are described by which candidate systems have been assessed and the possible impacts upon boiler operation evaluated. The cost-effectiveness of low NO/sub x/ technologies is being quantified by large-scale and long term tests. It is expected that intensive monitoring will be carried out over a three year period to assess impact on boiler performance, emissions, operability and corrosion and to quantify the additional operating costs and limitations arising from modification of the combustion system. 2 refs.

44903 **(ECE—EB.AIR/SEM.1/R.39) Fluidized bed combustion and desulphurization of combustion gases in Czechoslovakia.** Macek, L. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 9p. (CONF-8605284—Summ.). Government of Czechoslovakia.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Low-grade lignite coal will play a role in electric power and heat generation in Czechoslovakia for a long time. Since combustion of these coals pollutes the environment, a special programme for environmental protection has been developed. An acceptable possibility seems to be the utilization of fluidized bed boilers for combustion and desulphurization of flue gases. Two prototypes of forced inside circulation type fluidized bed boilers with capacities of 0.5 and 20 MW were put into operation in 1984. Desulphurization efficiency of more than 80% was verified during the trial operation. The boilers have proved to be suitable for low-grade coal combustion and for application in a central heat supply network. A comparison is given of the three types of fluidized bed boilers - natural circulation type, inside forced-circulation, and outside forced-circulation type - as well as of fluidized-bed furnaces.

44904 **(ECE—EB.AIR/SEM.1/R.44) Flue gas desulphurization by dry injection - pilot scale tests.** Gaarding, M.; Svedberg, G. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 10p. (CONF-8605284—Summ.). Government of Sweden.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

When a dry sorbent, e.g. sodium bicarbonate, is injected into the duct work upstream of a baghouse, SO_2 reacts with the sorbent in the flue gas and on the surface of the bag-filters. The resulting products are collected together with the fly ash. A pilot scale test financed by the Swedish Thermal Engineering Research Unit has now been completed. A slip-stream was withdrawn from a coal-fired experimental boiler through a baghouse. Injection of a stoichiometric amount of the smallest fractions of sodium bicarbonate resulted in an 80% SO_2 removal rate. The SO_2 removal efficiency was strongly dependent on the injection temperature, at least up to 230 C. The marked dependence on the injection temperature, and the rapid SO_2 concentration decline after start-up of the injection, indicate that the reaction between $NaHCO_3$ and SO_2 is very fast at a sufficiently high temperature. This means that a long residence time on the bag-filter cake might not be necessary, and that the technique thus could be used in connection with an electrostatic precipitator.

44905 **(ECE—EB.AIR/SEM.1/R.43) Flue gas desulphurization using a regenerative heat exchanger - the Invertex concept.** Lindqvist, O.; Ljungstrom, E.; Karlsson, L.; Karlsson, L. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 11p. (CONF-8605284—Summ.). Government of Sweden.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

INVERTEX is a patented concept which combines a cheap, simple method for flue-gas desulphurization with an increase in the efficiency of combustion furnaces. The principle of the method is outlined, followed by a description of the design and operation of a pilot plant which simultaneously carries out the desulphurization of flue gas and the heating of air. Results of experiments with de-dusted flue gas and stationary beds, de-dusted flue gas and bed regeneration, and without dust-cleaning but with bed regeneration are discussed.

44906 **(ECE—EB.AIR/SEM.1/R.6) By-product utilization and waste disposal introductory report.** Wijdeveld, H.W.J. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 7p. (CONF-8605284—Summ.). United Nations Economic Commission for Europe.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

This introductory report deals only with the utilization and disposal of the by-products/wastes from flue gas desulfurization (FGD) processes. The number of FGD installations is increasing rapidly; examples are given which highlight the development of desulfurization technologies, and future implications of waste disposal are listed. The report summarizes the major features of the submitted papers, and extracts points for discussion. A list of submitted papers is given.

44907 **(ECE—EB.AIR/SEM.1/R.1) Strategies for reducing sulphur and nitrogen emissions in relation to energy production structure and energy use.** Johannson, T.B. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 8p. (CONF-8605284—Summ.). United Nations Economic Commission for Europe.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The emission level of a harmful substance may be influenced by the formation during combustion of the compound per unit of energy used, the effects of cleaning equipment, the efficiency in converting a primary energy source to a form suitable for final use,

or the final energy demand. This topic considers different approaches to reducing emissions; in addition to those factors already mentioned, these may comprise fuel selection, fuel cleaning, boiler modifications and flue gas treatment. Emission reductions obtained and planned by Finland, the Federal Republic of Germany, Sweden, Switzerland, and Turkey are included in the submitted papers, as well as the efficient use of energy, energy production structure and costs.

44908 **(ECE—EB.AIR/SEM.1/R.3) Low-emission combustion processes.** Hupa, M. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 5p. (CONF-8605284—Summ.). United Nations Economic Commission for Europe.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

This topic deals with the control of SO_2 and NO/sub x/ emissions by choosing combustion processes which generate low emissions. The discussion is divided into two parts: a) conventional firing systems, and b) fluidized-bed combustion (FBC). Most low-NO/sub x/ and low-SO/sub x/ development efforts on conventional firing systems have been focused on pulverized coal firing, since this is the dominating source of emissions in central Europe. Low-NO/sub x/ burners are already available for fossil fuels, reducing NO/sub x/ emissions by 30-50%. Direct desulphurization by injecting alkaline additives into the flame of the furnace chamber has been tested in many countries. FBC technology is divided into three categories: stationary FBC, circulating FBC and pressurized FBC. A list of submitted papers is given.

44909 **(ECE—EB.AIR/SEM.1/R.4) Flue-gas desulphurization and denitrification: control of SO_4 and NO/sub x/ emissions from industrial processes.** Nestaas, I. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 8p. (CONF-8605284—Summ.). United Nations Economic Commission for Europe.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The papers included in this topic concern processes for combined SO/sub x/ and NOx control. This introductory report considers such combined processes with respect to SO/sub x/ control. Flue gas and industrial off-gas desulphurization processes are described which use the following scrubbing media: lime/limestone, wet; lime/limestone, dry and dry/wet; sea water; carbon; copper oxide; and ammonia, wet. Also covered are industrial applications, flue gas cleaning systems, and costs of flue gas desulphurization. A list of submitted papers is given.

44910 **(ECE—EB.AIR/SEM.1/R.2) Fuel treatment.** Miller, C.L. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 11p. (CONF-8605284—Summ.). United Nations Economic Commission for Europe.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Efforts are currently being made to develop effective methods for the control of emissions generated through the use of fossil fuels as a source of energy. At the pre-combustion stage, such techniques as fuel selection, physical and chemical beneficiation, fuel conversion and fuel upgrading are receiving considerable attention as methods for reducing the level and eliminating contaminants from solid or liquid fuels. These techniques or processes are the focus of the papers submitted. This introductory report summarizes the major features of the submitted papers under the following headings: 1) coal beneficiation; 2) coal conversion; and 3) fuel upgrading. A list of submitted papers is given.

44911 **(ECE—EB.AIR/SEM.1/R.56) Reduction of sulphur and nitrogen oxide emissions from fluidized bed boilers by control of combustion conditions.** Seaton, P. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 10p. (CONF-8605284—Summ.). Government of the United Kingdom.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Fluidized bed boilers offer the advantage of control of emissions of SO/sub x/ by addition to the bed of sorbents such as limestone or dolomite and also reduced NO/sub x/ emissions due to the lower combustion temperatures compared to other conventional coal fired boilers. The oxides of nitrogen produced by the combustion of coal are formed as intermediate products in reactions concerning nitrogen derived from the atmosphere and nitrogen present in the fuel. The formation of NO from atmospheric nitrogen is dependent on high oxygen concentration and high temperatures. In the case of pf burners, two-stage combustion has been shown to reduce NO/sub x/ emissions. The Energy Equipment Company Limited has also used the principle of two-stage combustion in the design of fluidized bed boilers in which primary air/recycle gas for fluidization is controlled to maintain oxygen-deficient combustion conditions in the bed while secondary air is introduced above the bed to complete combustion. Trials have shown that NO/sub x/ emissions are further reduced by this technique when compared to conventional oxidizing bed FBCs.

44912 **(ECE—EB.AIR/SEM.1/R.53) Recent developments in low cost flue gas desulphurization systems in the Netherlands.** Wijdeveld, H. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 14p. (CONF-8605284—Summ.). Government of the Netherlands.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The re-introduction of coal as a fuel for power stations in the second half of the 1970s necessitated the implementation of the desulfurization techniques for the gases. At the same time rapid development took place in legislation related to the implementation of control technologies and various contractual obligations ensured active research into flue-gas desulfurization (FGD) projects. In 1986 all new coal- and oil-fired power stations were obliged by law to use a 100% FGD system. Existing units expected to continue operation after 1995 will have to be equipped with a full FGD system by 1989. Other features of Dutch FGD's include no prescrubbers, one absorber per boiler, no separate oxidation/pH control vessels, no large thickener only a battery of small hydrocyclones, no batch-type centrifuges but a continuous water removal system instead and no reheating of flue gases.

44913 **(ECE—EB.AIR/SEM.1/R.54) Flue gas desulphurization at Oeresundverket, Malmoe, Sweden.** Lindsjoe, L. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 14p. (CONF-8605284—Summ.). Government of Sweden.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The paper describes why and how Sydkraft AB has built a so-called wet-dry desulfurization plant at Oeresundsverket in Malmoe (Sweden). The first operational experiences are summarized and the status of an advanced development programme is discussed. Results obtained so far verify the expected performance requirements, the economics are satisfactory, but design features, components and working environments need to be further investigated.

44914 **(ECE—EB.AIR/SEM.1/R.59) Fundamentals of flue-gas desulphurization with aqueous solution of Na_2SO_3 - $NaHSO_3$ at absorption temperatures up to 70 C.** Weiss, S.; Trothe, R.; Schumann, U. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 11p. (CONF-8605284—Summ.). Government of the German Democratic Republic.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Flue gas desulphurization with an aqueous solution of Na_2SO_3 - $NaHSO_3$ is an important process for sulphur recovery in the form of sulphur dioxide and sulphuric acid, respectively. In the combustion of lignite, the saturation temperature for water vapour in flue gas is 58 C to 65 C. Consequently, absorption has to take place at this relatively high temperature. Temperature affects the reaction rate, solubility of SO_2 in the liquid phase and the diffusion. The effects of the essential parameters on a valve grid plate 0.2 metres in diameter are investigated.

44915 **(ECE—EB.AIR/SEM.1/R.66) Situation and control of air pollution in Ankara/Turkey.** Ileri, A. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 5p. (CONF-8605284—Summ.). Government of Turkey.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

This paper outlines the air pollution problems that occur in Turkey's capital city, Ankara. In the winter climatic and geographical circumstances lead to a lignite/fuel oil induced smog. Various solutions have been suggested including a switch to natural gas in key areas of the city. Other solutions suggested include the conversion of lignite to coke to reduce the SO_2 emission, the addition of lime to lignite and other long-term plans including greater electricity production, better heat insulation and district heating systems.

44916 **(ECE—EB.AIR/SEM.1/R.69) Problems in the disposal of by-products with long-term thermal stability: fly ash and flue gas gypsum.** Lukas, W. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 11p. (CONF-8605284—Summ.). United Nations Economic Commission for Europe.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

This paper discusses the problems in the disposal of by-products with long-term thermal stability, in particular fly ash and flue-gas gypsum. Both these products will increase in the future and will no longer be recycled to the same extent as at present. Special requirements with regard to water permeability at the disposal sites will be needed. Possibilities include various preparation techniques including the pozzolanic reaction of fly ash mixtures with hydraulic activators giving dynamic strength to the end-product. The stabilization through these processes also leads to lower permeability and leaching behaviour.

44917 **(ECE—EB.AIR/SEM.1/R.70) Secondary utilization of furnace limestone injection ash.** Staudinger, G. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 13p. (CONF-8605284—Summ.). Government of Austria.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Since the conversion of a limestone additive injected into a pulverized fuel fired furnace in practice hardly exceeds 12%, another means must be found to utilize the CaO contained in the ash with a three-to-eight-fold excess ratio relative to the remaining SO_2 in the flue gas. This high alkaline ash can be slaked and used as an absorbent in a spray dryer or in a wet flue gas desulphurization process. Both applications may be economically advantageous under certain conditions. A more attractive method would be to increase the residence time of the additive particle in the flue gas duct and let it react with SO_2. This can easily be achieved with a fabric filter. Experiments showed that the reaction rate at usual operating temperatures is very small and as a result impractically long residence times would be required. It was found that treatment of the ash by milling and hydration with steam gives a reactive, dry product permitting effective desulphurization of the flue gas in a fabric filter. 7 refs.

44918 **(ECE—EB.AIR/SEM.1/R.71) Technologies for controlling pollutants from coal combustion.** Ponder, W. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 19p. (CONF-8605284—Summ.). Government of the United States of America.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Some of the advanced technologies, for air pollution control, show great promise for more efficient removal of pollutants at lower costs. Scientists of the United States of America are particularly encouraged with the cost saving potential of Limestone Injection through Multi-stage Burner (LIMB), Electrostatic Precipitator Particle Removal and Spray Dryer Removal Process (E-SOX), Staged Electrostatic Precipitators and Electrostatic Enhancement of Fabric Filtration which are currently under development by the U.S. Environmental Protection Agency. For example, the application of LIMB (approximately 60% SO_2 removal) as a partial substitute for flue gas desulphurization (approximately 90% SO_2 removal) may result in cost savings as great as $670 per ton SO_2 removed. This estimate is based on a 300 MW utility boiler firing coal which contains approximately 2% sulphur.

44919 **(ECE—EB.AIR/SEM.1/R.72) US Department of Energy's flue gas cleanup research and development programme.** Perlsweig, M. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 25p. (CONF-8605284—Summ.). Government of the United States of America.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The US Department of Energy conducts an extensive research and development programme on flue gas cleanup for coal-fired utility and large industrial boiler applications. The major areas of emphasis are on simultaneous SO_2 and NO/sub x/ control, primarily for application to new construction, and desulphurization for application to new low-sulphur coal-fired boilers requiring only 70% control as well as for retrofit to existing uncontrolled boilers using high sulphur coals, in the event that legislation currently under consideration to reduce emissions from existing sources is enacted. Descriptions of the processes currently under development are provided in the paper along with current status, future plans, research results and economic evaluations where available. The simultaneous SO_2/NO/sub x/ control category includes electron beam enhanced processes in conjunction with lime spray drying and ammonia injection; dry regenerable processes using Na_2CO_3 and CuO deposited on alumina substrates, and additives for lime spray processes to provide NO/sub x/ control.

44920 **(ECE—EB.AIR/SEM.1/R.78) Use and disposal of end-products (Stabilisa) of spray dryer absorption process.** Neumann, G. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 5p. (CONF-8605284—Summ.). United Nations Economic Commission for Europe.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The end-products of the spray dryer absorption (SDA) process contain considerable amounts of calcium and sulfur and exhibit hydraulic/pozzolanic properties. These end products can be used for: (1) building materials; (2) cement fabrication; and (3) combined production of sulfuric acid and cement clinker by the Mueller-Kuehne-Process. Before disposal of the SDA end-products, conditioning is necessary, the high compressive strengths and low permeabilities qualify these materials as non-hazardous waste suitable for landfill and land reclamation.

44921 **(ECE—EB.AIR/SEM.1/R.81) SO_2 recovery by means of adipic acid buffers.** Erga, O. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 10p. (CONF-8605284—Summ.). Government of Norway.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

This paper reports on a new process for SO_2 removal from gases. The process is based on the use of aqueous sodium adipates in adsorption and steam stripping. The process produces SO_2 ready for further processing to liquid SO_2 or H_2SO_4. The adipate process is shown to supplement the Citrate process and is best suited for relatively rich gases and low absorption temperatures. The chemistry of the two processes, adipate and citrate, is similar and they both offer many advantages. These are discussed in this paper. 9 refs.

44922 **(ECE—EB.AIR/SEM.1/R.82) State of the art of the dry limestone-additive method.** Kluge, W. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 7p. (CONF-8605284—Summ.). German Democratic Republic.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The dry flue-gas desulfurization by addition of calcium compounds to the combustion is increasingly used as the first and simplest stage for the reduction of the SO_2 emission, especially for brown coal using limestone addition. The state of the art of dry

limestone addition is reviewed including the benefits and drawbacks associated with the process; including multi-stage processes for desulfurization of brown coal.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 44864, 44891, 44915, 44958, 44960, 44961, 45319, 45320, 45321

44923 (DOE/FE/60177—2305-Vol.1, pp 216-219) **Environmental site evaluation - Hanna.** Berdar, G.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Underground coal gasification (UCG) experiments at the Department of Energy's (DOE) site near Hanna, Wyoming, in the 1970s resulted in six underground cavities in the Hanna No. 1 coal seam, an areally limited water-bearing coal seam of low permeability. Ground water monitoring at the Hanna site has been conducted since 1977, with sampling on a quarterly basis since 1980. Monitoring wells were completed in the coal seam and in units A and C. Results of analyses indicate dilute concentrations of pyrolysis and leaching products exist primarily in ground waters of the six cavities. Three primary UCG-indicator parameters have appeared at elevated (above baseline) concentrations: phenols, ammonia, and sulfate. The objectives of this research were to define the extent and concentration of contaminants in the ground water; identify restoration requirements and methodologies; and develop plans to restore the ground water to acceptable quality as determined by Wyoming regulatory agencies.

44924 (DOE/FE/60177—2305-Vol.1, pp 219-222) **Hydrological testing at the Tono II UCG site.** Oliver, R.L.; Healy, M.J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Recent DOE-supported underground coal gasification (UCG) research has emphasized technological advancement to support the mitigation of environmental impacts and the development of UCG commercialization. The Tono II test, proposed for a site near Centralia, Washington, was to be the first test to incorporate the use of dual modules and a comprehensive site characterization program. The site characterization program included both geological and hydrological evaluations. The project was not completed, however, since the site was abandoned because of nontechnical issues. The main objectives of the hydrologic testing conducted at the site were to identify water-bearing zones within the strata, determine coal seam transmissivity, and identify any directional permeability. These parameters greatly affect process efficiency because of water influx and their identification is necessary for predicting and mitigating ground water contamination.

44925 (DOE/FE/60177—2305-Vol.1, pp 222-228) **Baseline evaluation of the hydrogeology and ground water quality of the proposed RM1 UCG site, Hanna, Wyoming.** Mason, J.M. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

As a part of the Wyoming Department of Environmental Quality Land Quality Division permitting requirements, the geohydrology and ground water quality of the proposed Rocky Mountain 1 (RM1) underground coal gasification (UCG) site, located near Hanna, Wyoming, was evaluated. The coal aquifer is susceptible to direct hydrologic impacts as a result of underground coal gasification. The collapse of overburden strata and the presence of the reactor cavity can alter the ground water flow regime. Also, ground water quality can be affected by pyrolysis products produced during gasification and leachate plumes. Baseline evaluation of the geohydrology and ground water quality will allow the impacts of UCG on the ground water system to be assessed. The baseline studies are also important with regard to UCG process and clean-up technology. Certain hydrologic constraints such as excessive water influx into the reactor cavities can have severe impacts on process design, operations, and clean-up. The objective of this research was to define the geohydrologic characteristics and baseline water quality of the RM1 site.

44926 (DOE/FE/60177—2305-Vol.1, pp 229-233) **Biological treatability and phenol degradation studies performed with UCG condensate and affected ground waters.** Nolan, B.T. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Underground coal gasification (UCG) condensates are complex waste waters whose total organic carbon concentration is comprised mostly of phenols (typically 4200-5200 mg/L). Because phenolic compounds are an excellent substrate for an acclimated biomass, several biotreatment options were considered for use with Hanna IVB condensate and Hanna ground water. Specific research objectives were the following: (1) University of Arizona activated sludge study - to evaluate the biotreatability of various dilutions of Hanna IVB condensate using chemostats; to determine kinetic coefficients; to determine the relationship between the specific substrate utilization rate and effluent substrate levels; to characterize contaminant removals; (2) University of Wyoming activated sludge study - to evaluate the effectiveness of various pretreatments; to determine kinetic coefficients; to evaluate the effect of various treatment options on contaminant removals; and (3) University of Wyoming phenol degradation study - to determine if ground water from the Hoe Creek UCG site contains indigenous bacteria capable of metabolizing phenol; to establish the limits of phenol concentration, time, supplemental nutrients, and dissolved oxygen for effective degradation of phenols.

44927 (DOE/FE/60177—2305-Vol.1, pp 233-238) **Physical-chemical treatment of UCG condensate and affected ground waters.** Nolan, B.T. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Several physical and chemical treatments were evaluated for their potential to remove contaminants from underground coal gasification (UCG) waste waters. The treatments included colloid-destabilization technologies, solvent sublation, membrane-separation methods, and carbon adsorption with various forms of media. Coagulation-precipitation and foam separation experiments were performed with condensate from a Hanna, Wyoming test site (Hanna IVB) to remove colloidal tars. Solvent sublation, a bubble-separation method, was investigated for its ability to simultaneously remove both tars and soluble organics from the condensate. Membrane separation experiments were employed to remove dissolved inorganics, colloidal tars, and soluble organics from Hanna ground water and simulated wastewater. Bench-scale carbon adsorption experiments were performed with simulated wastewater to evaluate the effectiveness of alternative media (coal and char). Lastly, a pilot-scale carbon-adsorption system was tested at the Hoe Creek, Wyoming, UCG site. Phenols and total organic carbon (TOC) removals from ground water were measured.

44928 (DOE/FE/60177—2305-Vol.1, pp 238-240) **Underground coal gasification water quality data base.** Barteaux, W.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Water quality data have been collected at the Hanna and Hoe Creek underground coal gasification (UCG) sites on an irregu-

lar basis since 1977. However, until 1984, the data were not in a format that allowed easy data analysis. In order to assess UCG impact on the sites, a data base was required to provide easy data entry, access and manipulation, as well as permanent data storage. Western Research Institute developed an underground coal gasification water quality data base in 1984 for the Department of Energy to fulfill this requirement. Objectives of data base development included the permanent, compact storage of UCG water quality data on magnetic tape; efficient, user friendly data input and retrieval; data base output that facilitates data analysis; limited programming and maintenance requirements; and small overall cost.

44929 (DOE/FE/60177—2305-Vol.1, pp 240-246) **Ground water transport model development.** Schreiber, J.D. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

For the new technology of underground coal gasification (UCG) to become viable and widespread, the environmental consequences have to be studied, predicted, and managed. One of the ways of doing this is to use numerical modeling of flow and water quality to assess the environmental impact after the burns have been completed. An environmental manager would like to know the distribution and location of the contaminant plume as a function of time over a given time span, say 20 years. These numerical tools will be useful to the manager faced with such problems. The purpose of this project was to develop the numerical tools to study the ground water flow and water quality problems associated with underground coal gasification.

44930 (DOE/FE/60177—2305-Vol.1, pp 247-251) **Contaminant control research for in situ thermal recovery processes.** Boysen, J.E. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

In January 1986, a research program was initiated to investigate the production and control of organic contaminants following shutdown of in situ thermal recovery processes. The research was focused on postburn pyrolysis following shutdown of underground coal gasification (UCG) operations. This initial research concentrated on three areas: (1) a numerical heat conduction model to simulate UCG postburn coal pyrolysis, (2) a physical model to simulate UCG postburn coal pyrolysis, and (3) an initial test program for physical model experiments. The specific objectives of the research were (1) to simulate with physical and mathematical models the pyrolysis and migration processes following shutdown of in situ thermal recovery operations, (2) to estimate postburn contaminant generation and recovery, and (3) to determine potential operating procedures for reducing postburn pyrolysis product generation and migration.

44931 (DOE/FE/60177—2305-Vol.1, pp 210-215) **Hoe Creek underground coal gasification site.** Barteaux, W.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Lawrence Livermore National Laboratory (LLNL) conducted three underground coal gasification (UCG) experiments at the Hoe Creek site near Gillette, Wyoming, in 1976, 1977, and 1979. The experiments are referred to as the Hoe Creek I, II and III tests. Although the environmental consequences of UCG have not been fully assessed, UCG impact on ground water quality at the Hoe Creek site appears significant. The objectives of this research were characterization of UCG-impact on the Hoe Creek ground water, including identification of contaminant plume location and solute transport mechanisms, and development of land and ground water quality restoration schemes.

0110 Reserves And Exploration

44932 **(ERP/CRL—85-9(CF)DECLASS) Nova Scotia peat resources evaluation: progress and status of peat chemistry file 1984.** Bonnell, G.W.; Corbett, G.R.; Young, D.A. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Jan 1985. 17p. CANMET.

As part of the joint Canada-Nova Scotia Mineral Development Agreement (1981), a program designed to contribute to mineral exploration and evaluation in Nova Scotia, provision was made for the development of a Peat Resource Inventory and Evaluation. This report presents an analysis of Nova Scotia peat samples collected in 1984. Analyses were conducted at the CANMET laboratory located at Sydney, Nova Scotia.

44933 **(LA-UR—87-877) Conversion of borehole Stoneley waves to channel waves in coal.** Johnson, P.A.; Albright, J.N. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-871012—2). NTIS, PC A02. File Number DE87007490.

From 57. annual international meeting and exposition of the Society of Exploration Geophysicists; New Orleans, LA, USA (11 Oct 1987).

Evidence for the mode conversion of borehole Stoneley waves to stratigraphically guided channel waves was discovered in data from a crosswell acoustic experiment conducted between wells penetrating thin coal strata located near Rifle, Colorado. Traveltime moveout observations show that borehole Stoneley waves, excited by a transmitter positioned at substantial distances in one well above and below a coal stratum at 2025 m depth, underwent partial conversion to a channel wave propagating away from the well through the coal. In an adjacent well the channel wave was detected at receiver locations within the coal, and borehole Stoneley waves, arising from a second partial conversion of channel waves, were detected at locations above and below the coal. The observed channel wave is inferred to be the third-higher Rayleigh mode based on comparison of the measured group velocity with theoretically derived dispersion curves. The identification of the mode conversion between borehole and stratigraphically guided waves is significant because coal penetrated by multiple wells may be detected without placing an acoustic transmitter or receiver within the waveguide. 13 refs., 6 figs., 1 tab.

0120 Mining

REFER ALSO TO CITATION(S) 44966, 44967

44934 **(BHP-CRL/R—25/86) Approaches to optical fibre based gas sensing in underground coal mines.** Stuart, A.D.; Samson, P.J.; Fredericks, P.M. (Broken Hill Proprietary Co. Ltd., Shortland (Australia). Central Research Labs.). 1986. 109p. BHP Central Research Laboratories, Shortland, Australia.

Three approaches to optical fibre based gas sensing of coal mine atmospheres, chemical sensor (optrode), the infrared absorption method, and the Raman method, have been surveyed and assessed. The optrode method is applicable to most coal mine gases, except methane and other hydrocarbons, provided that suitable intermediate chemicals can be found. The infrared absorption method has been proven for methane but is not applicable to other IR active gases unless the relatively inexpensive silica fibres such as those made from heavy metal fluorides are used. At present IR fibres are expensive, have high attenuations, and are not available in lengths suitable for extensive underground coal mines. The Raman method was found to have the potential to be relatively simple and effective, and should be applicable to most coal mine gases. However, the Raman effect is extremely weak, making detection of the normally low levels of carbon monoxide in mines unlikely. The recommendation, therefore, is that the Raman method be pursued for all gases and that, concurrently, the optrode method be pursued with particular emphasis on carbon monoxide. No further work is warranted on the IR absorption method at this stage, unless significant technological advancements are made.

44935 **(CSIRO-DG-GCM—65) Three-dimensional stress changes in pillars during longwall mining at Ellalong Colliery.** Wold, M.B.; Pala, J. (Commonwealth Scientific and Industrial Research Organization, Mount Waverley (Australia). Div. of Geomechanics). 1986. 44p.

CSIRO, Institute of Energy and Earth Resources, Division of Geomechanics.

Strong sandstone roof conditions at the Ellalong Colliery have led to widespread abutment loads during longwall extraction. In the barrier pillar and the chain pillar adjacent to the first longwall block, roadway closures and stress changes in the coal were monitored as mining progressed. The full triaxial stress changes were measured using CSIRO Hollow Inclusion cells. Vertical stress changes were also measured by the conventional Irad gauge method. The results are compared with 2- and 3-dimensional numerical methods. Good agreement was found between the 3-dimensional elastic model and the measured stresses in the initial stages, until passage of the longwall face. The measurements then show that rotated and highly non-uniform pillar stresses developed. This was probably associated with bridging and failure of the strong sandstone roof, and extrusion of the soft mudstone floor. The results suggest that pillar design methods should be developed to cope with failure within adjacent roof and floor strata. Some technical aspects of the use of the CSIRO Hollow Inclusion Cell, and the Irad gauge are discussed.

44936 **(ECE/COAL—110) Mechanization of ancillary work in the case of combined transport and transport by lorry.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 16 Mar 1987. 5p. Economic Commission for Europe, Geneva (Switzerland). Coal Committee.

This consolidated report covers the mechanization of ancillary work in the case of combined transport systems and lorry transport systems in large opencast coal mines of the USSR. The areas investigated include the mechanization of ancillary work in opencast sites in respect to truck roadways, the equipment used in the construction and maintenance of the roadways, and the servicing and repair of the opencast site vehicles. Also the advantages and disadvantages of using combined road/rail, conveyor/road and conveyor/rail transport systems are reviewed. Other countries such as Poland and Czechoslovakia were also discussed to compare their integrated surface mining transportation systems.

44937 **(ECE/COAL—111) Exploration by geophysical methods, extraction and transport of hard rock inclusions during overburden removal.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 16 Mar 1987. 10p. Economic Commission for Europe, Geneva (Switzerland). Coal Committee.

This consolidated report summarizes the information available to date on the choice of method for extracting hard inclusions at opencast coal mines. A questionnaire was prepared on this problem and replies were received from the Governments of the USSR, Czechoslovakia, Poland, Hungary, the German Democratic Republic, Bulgaria, the United Kingdom and Turkey. The questions concerned primarily: the detection, through geophysical survey, of areas with hard-to-work overburden; the technology employed for the extraction of hard inclusion; and the equipment used to transport such material.

44938 **(ERP/CRL—84-38(CF)DECLASS) Calculation of the width of barrier pillar required to protect a development drivage against inundation.** Cain, P. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Nov 1984. 15p. CANMET.

This report was initiated in response to a request as to recommendations for dimensions of barrier pillars which would be required to protect a development entry from inundation by water from abandoned workings. In the process of examining this problem an analysis of possible modes of pillar failure and stability calculations were also discussed. Results of calculations indicated the recommended minimum pillar width to be 54.64 m in cohesionless ground or 7.15 m in cohesive ground. 2 refs.

44939 **(ERP/CRL—85-31(CF)DECLASS) Review of a proposed development for the east districts at Lingan Colliery.** Cain, P. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Mar 1985. 12p. CANMET.

This report provides a brief review of the stability of mine roadways serving the proposed extraction panels on the east side of Lingan Colliery. A potential system was proposed for extraction but was eventually discarded in favor of the use of monolithic pumped packings 2 refs.

44940 **(ERP/CRL—86-102(TR)) Vehicle monitoring system at Widco mine.** Srajer, V. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Sep 1986. 20p. CANMET.

The mining system and the vehicle monitoring system (VMS) at the Widco coal mine in Centralia, Washington were examined by representatives from CANMET and Gregg River Resources Ltd., to determine the feasibility of their use in a Hinton, Alberta mine. The Widco mine uses a bucket wheel excavator to remove overburden and shiftable conveyors to transport coal and waste material. Their stacker/spreader machine unit was specially designed for the site. The VMS is a truck functions management system that collects and monitors operations of off-highway vehicles at the site, and also acts as a warning system for equipment malfunction. The system also has a historical recording system for post-failure diagnostics and preventative maintenance trend analysis. 3 refs.

44941 **(ERP/CRL—86-104(IR)) Triaxial testing of brittle sandstone using a multiple failure state method.** Cain, P.; Yuen, C.M.K.; LeBel, G.; Crawford, A.; Lau, D. (Canada Centre for Mineral and Energy Technology, Sydney, Nova Scotia. Cape Breton Coal Research Lab.). Sep 1986. 20p. CANMET.

A research program to investigate sandstone/methane outbursts in coal bearing rocks is described. A sandstone reference material had to be used in the development and trial of the testing procedure as samples from the affected mine were limited. A triaxial testing method for characterizing rock properties which was used is described. The brittle nature of the reference material made control of failure by monitoring axial strain impossible. An alternative method of detecting imminent failure in the specimens was developed which more accurately reproduces single state test conditions than the International Society of Rock Mechanics (ISRM) standard does. 4 refs.

44942 **(ERP/CRL—86-113(TR)) Development of a computer model of a continuous digging machine Easi-Miner at Obed Mountain mine.** Srajer, V.; Acott, G. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Oct 1986. 21p. CANMET.

This report presents a proposal for field work, to collect and evaluate operational data for the Easi-Miner operation at Obed Mountain mine, Alberta. This data will then be used to develop a computer model which will serve as a basic monitoring and event-based modelling tool of the continuous mining operation system currently used at the mine. The initial specifications of the proposed computer model are included. 5 refs.

44943 **(ERP/CRL—86-123(TR)) Simplistic classification of Western Canadian coal seams with respect to their potential for development as underground mines.** Kolada, R. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Nov 1986. 16p. CANMET.

A simplistic method of classifying Western Canadian coal seams with regard to future underground mining methods is discussed. The classification scheme is based on three factors: gradient, seam thickness and location. 1 ref.

44944 **(EUR—10665-EN) Computer-based coal clearance for a multi-mine complex.** (Commission of the European Communities, Luxembourg). 1986. 338p. British Coal, London (United Kingdom).

British Coal reorganised its Barnsley area into three multi-mine complexes and undertook the development of computerized monitoring and control real time system suitable for a multi-mine complex based on the Minos system. The project was divided into two phases: Phase 1 was to bring up to standard the underground conveyor network to ensure its suitability for remote control and provide standard Minos facilities until Phase 2 was available; Phase 2 was to further develop the Minos system to provide facilities for a multi-mine complex. Part 1 of the report describes the work carried out in Phase 1, and Part 2 describes the work carried out in Phase 2. Work was delayed by the industrial dispute of 1984/85, however the delay allowed improvements to be made to the microprocessor system before installation. In October 1984 a major review of Phase 2 was carried out at MRDE and, due to advances in technology and standard Minos facilities, the option of using standard Minos for West Side became available. It was decided to adopt the standard Minos system. Invaluable experience in distributed processing techniques has been gained and many of the Phase 2 facilities have been integrated into standard Minos.

44945 **(EUR—10666-EN) Reliability prediction techniques.** Whittaker, B.; Worthington, B.; Lord, J.F.; Pinkard, D. (British Coal, London (UK)). 1986. 364p. Commission of the European Communities.

The paper demonstrates the feasibility of applying reliability assessment techniques to mining equipment. A number of techniques are identified and described and examples of their use in assessing mining equipment are given. These techniques include: reliability prediction; failure analysis; design audit; maintainability; availability and the life cycle costing. Specific conclusions regarding the usefulness of each technique are outlined. The choice of techniques depends upon both the type of equipment being assessed and its stage of development, with numerical prediction best suited for electronic equipment and fault analysis and design audit suited to mechanical equipment. Reliability assessments involve much detailed and time consuming work but it has been demonstrated that the resulting reliability improvements lead to savings in service costs which more than offset the cost of the evaluation.

44946 **(EUR—10718-DE) Maintenance of efficient main shaft winding at great depths.** Breuker; Cornelius; Hoehle. (Steinkohlenbergbauverein, Essen (Germany, F.R.)). 1986. 117p. (In German). Commission of the European Communities.

The paper considers the use of compact wedge capels, a compact driving sheave and winding ropes. Friction between ropes and the driving sheave is also discussed. Wedge capels are the rope end connector most widely used in shaft winding. Compact wedge capels to contain several ropes were developed to reduce the weight of using several capels, however these did not weigh significantly less than a combination of conventional wedge capels. The performance of the sheave and the wear characteristics, friction behaviour and load stability of the lining showed no disadvantages compared with conventional driving sheaves. The durability characteristic of the rope sets used was premature rope fatigue. Friction coefficients of the six rope set on the compact driving sheave were established. These fell within the range identified in separate lining trials on the friction test rig.

44947 **(MERP/CRL—86-110(TR)) Potential for blast casting in Canadian surface mines.** Naidu, H.G.; Singhal, R.K.; Clausen, G.; Currie, J.A. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Oct 1986. 21p. CANMET.

The existing global technology for the use of explosives to cast overburden (blast casting) was reviewed and situations for its use in Canadian mines identified. Blast casting has been used worldwide to mine higher strip ratio pits and to improve the economics of mining existing pits. 8 refs.

44948 **(ORAU/IEA—87-1-M) Electricity and technical progress: The bituminous coal mining industry, mechanization to automation.** Devine, W.D. Jr. (Oak Ridge Associated Universities, Inc., TN (USA)). Jul 1987. Contract AC05-76OR00033. 89p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87014233.

Development and use of electric mobile machinery facilitated the mechanization of underground bituminous coal mining and has played a lesser but important role in the growth of surface mining. Electricity has been central to the rise of mechanically integrated mining, both underground (after 1950) and on the surface (recently). Increasing labor productivity in coal mining and decreasing total energy use per ton of coal mined are associated with penetration of new electric technology through at least 1967. Productivity declined and energy intensity increased during the 1970s due in part to government regulations. Recent productivity gains stem partly from new technology that permits automation of certain mining operations. On most big electric excavating machines, a pair of large alternating current (ac) motors operate continuously at full speed. These drive direct current (dc) generators that energize dc motors, each matched to the desired power and speed range of a particular machine function. Direct-current motors provide high torque at low speeds, thus reducing the amount of gearing required; each crawler is independently propelled forward or backward by its own variable-speed dc motors. The principal advantages of electric power are that mechanical power-transmission systems - shafts, gears, etc. - are eliminated or greatly simplified. Reliability is higher, lifetime is longer, and maintenance is much simpler with electric power than with diesel power, and the spare parts inventory is considerably smaller. 100 refs., 11 figs., 12 tabs.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 44957

0140 Combustion

REFER ALSO TO CITATION(S) 44818, 44844, 44859, 44891, 44899, 44903, 44908, 44911, 44918, 44922, 45316, 45317, 45318, 45319, 45320, 46044

44949 **(DOE/MC/22024—2339-Vol.1) Fluidized-bed combustion development: Volume 1, Industrial steam generation: Final report.** Gaglia, B.N.; Claussen, R.L. (Stearns Catalytic Corp., Denver, CO (USA)). May 1986. Contract AC21-85MC22024. 283p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87006478.

In 1986 Stearns Catalytic performed a study for the US Department of Energy to investigate methodology for improving the economics of atmospheric fluidized bed combustion (AFBC). This report is a result of Phase 1 of this program. The scope of this work involved reviewing the four unit sizes listed: 10,000, 50,000, 100,000, and 200,000 lbs/h. The design conditions and plant application were established at 350 psig saturated steam, with no electric power generation. The approach of the study was to first review AFBC concepts and to compare the various options available. A complete plant description was developed using a system by system breakdown. This Phase 1 report includes a review of the basic technology of fluidized bed combustion and discusses the various regimes of fluidization. There are generally two accepted types of fluidized bed boilers for burning solid fuels, namely, the Bubbling Fluidized Bed (BFB) and the Circulating Fluidized Bed (CFB). Both of these technologies have found popular use for industrial steam generation. This report includes information on design, cost, and economics throughout the size range for both of these technologies. The results of the study, including the performance and cost of an industrial fluidized bed combustion steam generator along with support data and information, are presented in fourteen sections. The costs developed are not absolute due to the budgetary approach manufacturers used for their pricing development. However, they are within a plus or minus 20% range and should be useful for comparisons. Numerous trend curves as well as sensitivity analyses have been used to compare technology and fuel variations. 160 refs., 53 figs., 64 tabs.

44950 **(DOE/MC/22024—2339-Vol.2) Fluidized-bed combustion development: Volume 2, FBC technology improvement options: Final report.** Gaglia, B.N.; Claussen, R.L. (Stearns Catalytic Corp., Denver, CO (USA)). Aug 1986. Contract AC21-85MC22024. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006479.

The objective of this study is to identify technology improvements which can be implemented to reduce the cost of AFBC industrial steam generation. The approach taken to accomplish this task was to develop ideas by use of a wide variety of sources. Generally speaking, this included engineers, manufacturers, and users. Standard practices were reviewed along with problem areas and potential solutions. Once this was accomplished, an organized brainstorming session using twelve knowledgeable and experienced engineers developed ~90 ideas for potentially improving AFBC technology. The method used to condense and rank these ideas in the most promising order was a systematic method of analytical evaluation. By a screening process, the list of 90 ideas was reduced to 19, which were then ranked according to a scoring system. The eight top ranked ideas were chosen for further review and evaluation. The conclusions indicate two primary areas of potential economic improvement. The first area appears to be the development of shop assembled/portable packaged FBC boilers and more use of modular design/construction techniques. The other area appears to be in the reduction of air and flue gas pressure losses thus saving fan horsepower. Two other areas of secondary importance are also worth further investigation and development. One idea involves the elimination of onsite fuel and limestone preparation equipment by purchasing preconditioned coal and limestone. This prepared feed material could then be stored and fed using pneumatic delivery vehicles. This approach appears to be very attractive to the smaller unit sizes. The second area of improvement involves the optimization of heat recovery from the ash removal system before disposal.

44951 **(DOE/MC/22024—2339-Vol.3) Fluidized-bed combustion development: Volume 3, Evaluation of FBC technology improvement options: Final report.** Rahbany, E.P.; Claussen, R.L. (Stearns Catalytic Corp., Denver, CO (USA)). Nov 1986. Contract AC21-85MC22024. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006480.

The objective of this phase of the study is to evaluate the benefit of various technology improvements for AFBC industrial steam generation. The technology improvements were identified by a previous phase of the study: Shop Assembly and Modular Construction of Boilers; Use of Delivery Vehicles as Storage Feed Vehicles; Reduction of Fan Power; Use of Natural Fluid Circulation in Lieu of Pumped Circulation; Minimize Bed Drain; and Off-Site Premix of Fuel and Sorbent. The evaluations determined the range of benefits that may be possible from each of the improvements and calculated the present value of the future benefits. The range of present worth (1990) of the benefits were: Reduction of Fan Power - $162-$303 million; Shop Assembly and Modularization - $118-$216 million; Minimum Bed Drain - $19-$37 million; Off-Site Premix of Fuel and Sorbent - $13-$24 million; Natural Circulation - $0.5-$0.9 million; and Use of Delivery Vehicles for Storage - Negative. The study determined evaluation factors for Auxiliary Power, Boiler Efficiency, Capital Cost, Availability and Construction Duration. The recommended priority of research is: (1) Shop Assembly and Modularization; (2) Reduction of Fan Power; (3) Minimum Bed Drain; (4) Off-Site Premix of Fuel and Sorbent; and (5) Natural Circulation. The recommendation is based on a combination of greater benefit and least risk that might result from the research.

44952 **(DOE/MC/22024—2339-Vol.4) Fluidized-bed combustion development: Volume 4, Research plan for FBC technology improvements: Final report.** Rahbany, E.P.; Claussen, R.L. (Stearns Catalytic Corp., Denver, CO (USA)). Jan 1987. Contract AC21-85MC22024. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006481.

This report defines the scope of research into AFBC Technology Improvements for industrial steam generation. The technology improvements were identified and the possible benefits to be derived were evaluated in earlier phases of this study. The most promising areas of research identified are: (1) Shop Assembly and Modularization; (2) Reduction of Fan Power; (3) Minimum Bed Drain; (4) Off-Site Premix of Fuel and Sorbent; and (5) Natural Circulation in Coolant Loop. In addition to defining the scope, an estimate of the cost and schedule for each research area has been made. The priority of research is fairly well established by the estimated Benefit/Cost ratio, and is in the order of research areas listed. Some savings in the cost of research may be achieved by combining research activities from different areas.

44953 **(DOE/PC/80511—T8) Hydrodynamics, mixing, and segregation in gas fluidized beds: Technical progress report, 22 April 1987 to 21 July 1987.** Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1987. Contract FG22-85PC80511. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014006.

This technical progress report covers the progress made in the project entitled "Hydrodynamics, Mixing, and Segregation in Gas Fluidized Beds," under Grant No. DOE FG22-85PC80511. Efforts during this period have been focused on the continued computation of solids turbulent stresses and on the study of the mechanism of the global fluctuating motion of the solids in fluidized beds. In the previous report we presented a new area-averaging statistical approach which enabled us to calculate the solids turbulent stresses from the experimental measurement of the motion of a tracer particle. Only partial results were completed at the time of that report. This effort has been continued and three complete sets of the results have been obtained. These are presented in the present report. Unfortunately, due to damage to some data discs, some of the particle tracking data have been lost. Hence the results here do not cover all of the conditions previously studied at the University of Illinois at Urbana-Champaign. 6 refs., 8 figs.

44954 **(DOE/PC/80752—T9) Detailed model for practical pulverized coal furnaces and gasifiers: Quarterly technical progress report No. 7 for the period 1 May 1987 to 31 July 1987: Ninth quarterly reporting period.** Smith, P.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 31 Aug 1987. Contract FG22-85PC80752. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014209.

On May 1, 1985, work was initiated on a contract sponsored by a consortium of industrial and governmental agencies aimed at development of a practical, 3-D coal combustion model. The general objective of this study is to improve and extend a generalized two-dimensional, pulverized coal combustion and gasification code for application to large-scale, practical configurations, and to evaluate and implement the resulting code on an industrial scale. This report summarizes work conducted during the first quarter of the third year (ninth quarter) of this contract. A summary of work accomplished during this quarter is given by task and includes only tasks where significant progress was made.

44955 **(DOE/PC/90279—T8) Advanced coal-fueled combustor for residential space heating applications: Topical report: Combustor design definition for the period 1 October 1986-30 April 1987.** Ruth, L.A.; Chen, S.L.; Kwan, Y.; Sommer, T.M. (Energy and Environmental Research Corp., Irvine, CA (USA)). Jun 1987. Contract AC22-86PC90279. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014210.

This report reviews combustor design concepts for an integrated combustor/heat exchanger which burns coal either as a slurry or as dry ultrafine coal and which is suitable for use in a range of residential space heaters. The performance goals for the combustor include a combustion efficiency exceeding 99%, rapid response time (less than 5 min to full load), reliability and safety comparable to oil-fired systems, no daily maintenance with scheduled maintenance not more frequent than twice a year, and a service life of 20 years. The important combustor design considerations are combustion chamber size (i.e., coal residence time), burner type and configuration, wall temperature, atomizer type/droplet size, pilot flame size, and the operating air preheat and excess air levels. Modeling of the combustion process showed that a fuel residence time of one second would be adequate to achieve 99% carbon burnout of ultrafine coal (with a maximum particle size of 40 μm) or a coal slurry (with a 500 μm droplet size), provided that agglomeration of coal particles does not occur. This residence time translates into a combustor volume of 2 ft^3, for example, a cylindrical chamber 1 ft in diameter and 2-1/2 ft long. Two types of burners are judged suitable for use in a coal-fired residential heater: swirl stabilized and hot refractory quarl stabilized. Various burner configurations utilizing these two principles will be evaluated during experimental testing. Wall temperature is another important

design parameter which impacts on both material of construction and combustor performance. The choice of construction materials include stainless steel and refractories. A steel wall, while probably more durable than refractory, would need to be cooled.

44956 **(ERP/ERL—86-45(TR)) Description of the Mark II atmospheric fluidized bed combustor at the Combustion and Carbonization Research Laboratory, CANMET.** Anthony, E.J.; Desai, D.L.; Friedrich, F.D.; Smith, D. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Aug 1986. 40p. CANMET.

A new larger pilot-scale atmospheric fluidized bed combustor (Mark II) operating at CANMET's Combustion and Carbonization Research Laboratory (CCRL) is discussed. The new equipment has a cross section of 380 x 406 mm, variable in-bed cooling and is capable of feeding both liquid fuel and a variety of solid fuels. This report describes the new facility and changes made in both equipment and operating procedures. It is felt that the facility provides a powerful and important tool for the rapid development of fluidized-bed combustion technology in Canada. 6 refs.

44957 **(EUR—10798-EN) Firing of coal-water mixture fuels and dense phase pulverized coal.** Allen, J.W. (NEI International Combustion Ltd. (UK)). 1986. 68p. Commission of the European Communities.

The report describes the handling and firing of pulverized coal in the dry powder form, conveyed in the dense phase mode, and in the form of a concentrated mixture with water, conveyed in the conventional liquid fuel mode. In the liquid form the coal fuel comprises 70% finely ground coal, 30% water plus 1% additives for viscosity and stability control. The particle size distribution of the final coal in the fuel and the actual additive package varied with each individual fuel producer. This placed extra demands on a single handling and firing system to handle these highly individual fuels. Because of this the work was carried out in three stages. The coal water mixture fuels were fired on a small rig, fundamental investigation of their atomization characteristics was carried out, and firing at up to 30 MW in a test rig was carried out. The work showed that depending upon combustion chamber conditions, satisfactory combustion performance could be obtained using boilers designed for conventional liquid fuels.

44958 **(NERDDP-EG—85-395) Study of long-term fouling behaviour of low rank coals.** Anderson, B. (National Energy Research, Development and Demonstration Council, Canberra (Australia)). 1985. vp. Department of Resources and Energy, GPO Box 858, Canberra, ACT 2601, Australia.

Long-term (at least several hundred hours) tests, under sootblown conditions, have proven necessary to provide a realistic assessment of the ash-related behaviour of Latrobe Valley coals. Convection pass deposits formed from the combustion of Yallourn and Morwell coals in the 1000-hour furnace are directly comparable with those formed in full-scale units burning similar coals - assessed on the basis of physical size and appearance, chemical composition, mineralogical phases and deposit microstructure. The test conducted on Flynn coals indicated a number of substantial problems including severe slagging, accentuated convection pass fouling, rapid rates of high temperature corrosion, poor electrostatic precipitator performance and high levels of gaseous chloride emissions.

44959 **(ECE—EB.AIR/SEM.1/R.19) Circulating fluidized bed combustion availability - operating experience of the five commercial Pyroflow units.** Bengtsson, L. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 10p. (CONF-8605284—Summ.). Government of Finland.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

The availability and operational performance of 5 solid fuel fired units in the 25 to 65 MW range in the Finland are considered in the paper. The load response and turn-down ratio in terms of standard oil firing are also discussed. The results from pilot plants, full-scale sulfur capture and emission tests are discussed together with the experience from a 15 MW commercial unit which had demonstrated full compliance with the stringent emission control standards of California (USA). Further commercial emission performance experience from additional units in the USA will be considered. Monthly availability and load factors are given for two units over three years of commercial operation and for three units for two years. Very few breakdowns were reported and these were mostly unrelated to the fluidized combustion technology. Annual availability exceeding 96.5% in all five cases discussed demonstrated the commercial viability of Pyroflow circulating fluidized bed combustion.

44960 **(ECE—EB.AIR/SEM.1/R.49) State and prospects of fluidized bed combustion in the Federal Republic of Germany.** Schilling, H. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 23p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Boiler manufactuers of the Federal Republic of Germany have adopted the technology of fluidized beds in their manufacturing programs. In total 35 boiler units of an overall capacity of about 1700 MW have been either built, are under construction or are planned. The largest plant will have a thermal capacity of about 300 MW, although capacities beyond this are possible. A special feature of fluidized bed systems is their adaptability to a wide range of feed coals as well as the reduction of pollutant emissions. Fluidized-bed combustion has vast possibilities for further development and special plants of the intrafluid and circofluid-type have been constructed for this purpose. Topics covered in the paper are: principle and basic variations of fluidized-bed combustion; plants existing in the Federal Republic of Germany; environmental aspects; economic considerations; and future research and development activities - construction of a component test plant. 13 refs.

44961 **(ECE—EB.AIR/SEM.1/R.77) Industrial cogeneration AFBC plants.** Nowotny, A. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 11p. (CONF-8605284—Summ.). Government of Austria.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

Atmospheric fluidized-bed combustion (AFBC) plants in energy-intensive industries are becoming more and more important as an economic alternative for producing heat and power. As a consequence of its widespread application fluidized-bed combustion contributes to an efficient reduction of environmental pollution. In-bed desulphurization by limestone or dolomite and low combustion temperatures result in low SO/sub x/ and NO/sub x/ emissions, thus avoiding the need for extensive flue gas treatment. Simmering-Graz-Panker AG has now built two industrial cogeneration plants based on this technology, one with a steam output of 70 t/h at 60 bar and 500 C, the other with 16 t/h at 40 bar and 450 C. A third plant designed for 25 t/h at 64 bar and 450 C, is under construction and will start operation in late summer of 1986. With some 32,000 hours of operation the plant performance, the operating experiences and the emission control results are given in some detail. Fluidised-bed combustion proves to be an efficient and environmentally sound technology, worth wider application, especially for low-grade fuels. 5 refs.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 45574, 45585

44962 **(DOE/FE/60765—T1) Summary of coal export project.** (Southern States Energy Board, Atlanta, GA (USA)). Jan 1987. Contract FG01-85FE60765. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011625.

Through the international coal project and related activities, SSEB has called attention to the problems and potential of the US coal industry. The program has provided an excellent format for frank discussions on the problems facing US coal exports. Every effort must be made to promote coal and its role in the southern economy. Coal is enjoying its best years in the domestic market. While the export market is holding its own, there is increased com-

petition in the world market from Australia, Columbia, China and, to a lesser extent, Russia. This is coming at a time when the US has enacted legislation and plans are underway to deepen ports. In addition there is concern that increased US coal and electricity imports are having a negative impact on coal production. These limiting factors suggest the US will remain the swing supplier of coal on the world market in the near future. This presents a challenge to the US coal and related industry to maintain the present market and seek new markets as well as devote research to new ways to use coal more cleanly and efficiently.

44963 **(EPRI-P—5444) Coal markets and utilities' compliance decisions: Final report.** Hewson, T.; Medine, E.; Sansom, R.; Schwartz, S.; Stamberg, J. (Energy Ventures Analysis, Inc., Arlington, VA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 309p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920587.

This study attempts to reduce the uncertainty in information required for future utility decisions in response to potential emissions reduction legislation. The study considered 3 different sulfur dioxide emissions reduction scenarios, designed to cover a wide range of potential legislation. The methodology employed a "bottom-up" approach to analyzing the economics of emission reduction decisions. This involved studying the plant-specific costs at most of the major coal-fired stations in the eastern 31 states. These costs included the capital and operating costs for retrofit of flue gas desulfurization systems, the suitability of alternate low sulfur coals in the boiler, the capital investment (including derating) in switching coals, and the increased coal transportation costs associated with coal switching. These "bottom-up" analyses were integrated with production costs for low sulfur and high sulfur coals and aggregated to develop industry impacts on the coal markets and utility decisions. Site-specific factors are important. Retrofit scrubbing costs vary substantially by powerplant, with some having relatively low costs (generally large, modern units with ample space) and some where the costs are extremely high. Some boilers have restrictions on their options to switch to low sulfur coal. The amount that transportation costs will increase when switching coal varies widely among powerplants based on location and method delivery. The effect of these site-specific factors is to create a diversity of emissions reduction decisions, resulting in substantial amounts of both scrubbing and switching. This study predicts that Central Appalachia will be the major source of low sulfur coal for coal switching. The price of this low sulfur coal is expected to rise by $1 to $8 per ton, depending on the reduction scenario. The very low-sulfur coal price could rise by as much as $11 per ton at high reduction scenarios. 43 figs., 36 tabs.

44964 **(EY—86007) Methods of market research data analysis for electric utilities. Second CRIEPI-EPRI workshop.** Ono, K. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1987. 47p. (CONF-8609322—Pt.2). CRIEPI, 1-6-1 Otemachi, Chiyoda-ku, Tokyo 100, Japan .

From 2. CRIEPI-EPRI workshop on energy analysis; Tokyo, Japan (24 Sep 1986).

Japanese society has passed through a period of high-level economic growth, changes in social and personal feelings have occurred and competition among industries is severe. The electric utilities must anticipate changes in attitudes and needs and respond accordingly. This report presents an examination of various methods for analyzing data derived from a questionnaire survey conducted in the Tokyo area in order to determine the makeup of consumer feelings and needs. Consideration is given to which analytical methods should be used, problems involved in using them and methods of solving these problems.

0160 Health And Safety

REFER ALSO TO CITATION(S) 44886, 44934, 46307

44965 **(ECE/COAL—107) Prevention and suppression of underground fires.** (United Nations, Geneva (Switzerland). Economic Commission for Europe). 19 Feb 1987. 9p. Economic Commission for Europe, Geneva (Switzerland). Coal Committee.

This summarizing report is a review of the prevention and suppression of underground fires in the following countries, Federal Republic of Germany, Belgium, United Kingdom, Turkey, Czechoslovakia, Poland, and the USSR. Areas investigated include the prevention of spontaneous combustion fires, the prevention of exterior ignition fires, the detection and monitoring of mine fires, the suppression of spontaneous combustion fires and finally the suppression of exterior ignition fires. The techniques and equipment used in the various countries are analysed and the influence of local conditions, technology utilization and coal types is discussed. The effects of careful mine planning, laboratory examination of the coal and full use of past experience is emphasised with various examples from the respective countries.

44966 **(NP—7900971) Annual report of the Secretary of Labor under the Federal Mine Safety and Health Act of 1977, Fiscal Year 1984.** (Mine Safety and Health Administration, Denver, CO (USA)). 1984. 61p. NTIS, PC A04/MF A01. File Number DE87900971.

Mine management, miners, and government agencies all faced safety challenges as the mining industry expanded in FY 1984. Coal mining employment increased by about 4000 compared with FY 1983. Coal production grew to 869 million tons, an increase of 84 million tons compared with the previous fiscal year. Metal and nonmetal mining also was on the increase, with about 3000 more metal and nonmetal miners employed than in FY 1983. Stone, sand, and gravel operations accounted for the greater part of the expansion. The mining industry's rapid growth in FY 1984 meant a greater need for careful safety management, through training, and constant vigilance to prevent injuries. MSHA conducted more than 100,000 mine inspections and investigations during the fiscal year. In addition, the agency made special efforts to improve hazard awareness among miners and mine management. Compared with FY 1983, the rate of fatal injuries showed a slight increase both in coal mining and in metal and nonmetal (non-coal) mining. The rate of all injuries declined to a new low at coal mines, but increased slightly at metal and nonmetal operations. 7 figs., 48 tabs.

44967 **(NP—7900975) Injury experience in metallic mineral mining, 1985.** (Mine Safety and Health Administration, Denver, CO (USA). Safety and Health Technology Center). 1987. 282p. (IR—1185). NTIS, PC A13. File Number DE87900975.

This Mine Safety and Health Administration (MSHA) informational report reviews in detail the occupational injury and illness experience of metallic mineral mining in the United States for 1985. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, occupation, and principal type of mineral. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report. For ease of comparison with other metal and nonmetallic mineral mining industries and with coal mining, summary reference tabulations are included at the end of both the operator and the contractor sections of this report. Data used in compiling this report were reported by operators of metallic mineral mines and preparation plants on a mandatory basis as required under the Federal Mine Safety and Health Act of 1977, Public Law 91-173 as amended by Law 95-164. Since January 1, 1978, operators of mines or preparation plants or both which are subject to the Act have been required under 30 CFR, Part 50, to submit reports of injuries, occupational illnesses, and related data. 3 figs., 46 tabs.

02 PETROLEUM

0201 Reserves

REFER ALSO TO CITATION(S) 45586

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 46341

44968 **(PB—87-200507/XAB) Study of physical processes on the US Mid-Atlantic Continental Slope and Rise.** (Science Applications International Corp., Newport, RI (USA)). May 1987. 525p. NTIS, PC PC E99.

Set includes PB—87-200515 through PB—87-200531.

The report describes three years of physical oceanographic research by Science Applications International Corporation (SAIC) and its subcontractors in the Mid-Atlantic Slope and Rise (MASAR) program. MASAR began in October 1983 and was designed to provide the Department of Interior's Minerals Management Service with sufficient information to allow assessment of the potential impacts of petroleum exploration and production activities on the Outer Continental Shelf of the Mid-Atlantic region. Several major tasks were undertaken: Determining the general seasonal circulation features; Quantifying and describing processes which produce variability; and Determining the degree to which the slope/rise circulation features influence the physical oceanography of the adjacent Mid-Atlantic continental shelf.

44969 **(PB—87-200515/XAB) Study of physical processes on the US Mid-Atlantic Continental Slope and Rise. Volume 1. Executive summary. Final report, September 1983-May 1987.** Brown, O.; Evans, R.; Watts, R.; Casagrande, C.; Hamilton, P. (Science Applications International Corp., Newport, RI (USA)). May 1987. 53p. (SAIC—86/7539/129-VOL-1). NTIS, PC A04/MF A01.

See also Volume 2, PB—87-200523; Also available in set of 3 reports PC E99, PB—87-200507.

44970 **(PB—87-200523/XAB) Study of physical processes on the US Mid-Atlantic Continental Slope and Rise. Volume 2. Technical presentation. Final report, September 1983-May 1987.** Brown, O.; Evans, R.; Watts, R.; Casagrande, C.; Hamilton, P. (Science Applications International Corp., Newport, RI (USA)). May 1987. 326p. (SAIC—86/7539/129-VOL-2). NTIS, PC A15/MF A01.

See also Volume 1, PB—87-200515 and Volume 3, PB—87-200531; Also available in set of 3 reports PC E99, PB—87-200507.

The report describes three years of physical oceanographic research by Science Applications International Corporation (SAIC) and its subcontractors in the Mid-Atlantic Slope and Rise (MASAR) program. MASAR began in October 1983 and was designed to provide the Department of Interior's Minerals Management Service (MMS) with sufficient information to allow assessment of the potential impacts of petroleum exploration and production activities on the Outer Continental Shelf (OCS) of the Mid-Atlantic region. Several major tasks were undertaken; Determining the general seasonal circulation features; Quantifying and describing processes which produce variability; and Determining the degree to which the slope/rise circulation features influence the physical oceanography of the adjacent Mid-Atlantic continental shelf.

44971 **(PB—87-200531/XAB) Study of physical processes on the US Mid-Atlantic Continental Slope and Rise. Volume 3. Appendix. Final report, September 1983-May 1987.** Brown, O.; Evans, R.; Watts, R.; Casagrande, C.; Hamilton, P. (Science Applications International Corp., Newport, RI (USA)). May 1987. 146p. (SAIC—86/7539/129-VOL-3). NTIS, PC A07/MF A01.

See also Volume 2, PB—87-200523; Also available in set of 3 reports PC E99, PB—87-200507.

The report describes three years of physical oceanographic research by Science Applications International Corporation (SAIC) and its subcontractors in the Mid-Atlantic Slope and Rise (MASAR) program. MASAR began in October 1983 and was designed to provide the Department of Interior's Minerals Management Service (MMS) with sufficient information to allow assessment of the potential impacts of petroleum exploration and production activities on the Outer Continental Shelf (OCS) of the Mid-Atlantic region. Several major tasks were undertaken: Determining the general seasonal circulation features; Quantifying and describing processes which produce variability; and Determining the degree to which the slope/rise circulation features influence the physical oceanography of the adjacent Mid-Atlantic continental shelf.

44972 **(PB—87-200986/XAB) Physical oceanographic study of Florida's Atlantic coast region - Florida Atlantic Coast Transport Study (FACTS).** (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 701p. NTIS, PC PC E99.

Set includes PB—87-200994 through PB—87-201018.

44973 **(PB—87-200994/XAB) Physical oceanographic study of Florida's Atlantic coast region - Florida Atlantic Coast Transport Study (FACTS). Volume 1. Executive summary. Final report, 9 January 1984-18 February 1986.** Rinkel, M.; Vargo, S.; Lee, T.; Schott, F.; Zantopp, R. (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 54p. NTIS, PC A04/MF A01.

See also Volume 2, PB—87-201000; Also available in set of 3 reports PC E99, PB—87-200986.

The goal of the study was to provide information on the eddy structures which had been observed to break off from the Florida Current and Gulf Stream along Florida's Atlantic coast from 27 to 30°N to aid in assessment of risks from oil and gas activities in the South Atlantic Planning Area. The study involved the combined use of moored current meter arrays, PEGASUS current profiler, satellite tracked surface drifters, and inverted echo sounder/bottom pressure gauges (IES/PGs) to directly measure currents and particle trajectories with the Florida Current and Gulf Stream and the adjacent shelf. Satellite sea surface temperature (SST) imagery was used as a supplementary tool in the study to help interpret the data from the field instrumentation. Field sampling was conducted from March 12, 1984 through June 19, 1985.

44974 **(PB—87-201000/XAB) Physical oceanographic study of Florida's Atlantic coast region - Florida Atlantic Coast Transport Study (FACTS). Volume 2. Technical report. Final report, 9 January 1984-18 February 1986.** Rinkel, M.; Vargo, S.; Lee, T.; Schott, F.; Zantopp, R. (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 429p. NTIS, PC A19/MF A01.

See also Volume 1, PB—87-200994 and Volume 3, PB—87-201018; Also available in set of 3 reports PC E99, PB—87-200986.

The goal of the study was to provide information on the eddy structures which had been observed to break off from the Florida Current and Gulf Stream along Florida's Atlantic coast from 27 to 30°N to aid in assessment of risks from oil and gas activities on in the South Atlantic Planning Area. The study involved the combined use of moored current meter arrays, PEGASUS current profiler, satellite tracked surface drifters, and inverted echo sounder/bottom pressure gauges (IES/PGs) to directly measure currents and particle trajectories with the Florida Current and Gulf Stream and the adjacent shelf. Satellite sea surface temperature (SST) imagery was used as a supplementary tool in the study to help interpret the data from the field instrumentation. Field sampling was conducted from March 12, 1984 through June 19, 1985.

44975 **(PB—87-201018/XAB) Physical oceanographic study of Florida's Atlantic coast region - Florida Atlantic Coast Transport Study (FACTS). Volume 3. Appendices. Final report, 9 January 1984-18 February 1986.** Rinkel, M.; Vargo, S.; Lee, T.; Schott, F.; Zantopp, R. (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 218p. NTIS, PC A10/MF A01.

See also Volume 2, PB—87-201000; Also available in set of 3 reports PC E99, PB—87-200986.

The goal of the study was to provide information on the eddy structures which had been observed to break off from the Florida Current and Gulf Stream along Florida's Atlantic Coast

from 27 to 30°N to aid in assessment of risks from oil and gas activities on in the South Atlantic Planning Area. The study involved the combined use of moored current meter arrays, PEGASUS current profiler, satellite tracked surface drifters, and inverted echo sounder/bottom pressure gauges (IES/PGs) to directly measure currents and particle trajectories with the Florida Current and Gulf Stream and the adjacent shelf. Satellite sea surface temperature (SST) imagery was used as a supplementary tool in the study to help interpret the data from the field instrumentation. Field sampling was conducted from March 12, 1984 through June 12, 1985.

44976 **(PB—87-207239/XAB) Alaska statewide and regional economic and demographic systems: effects of OCS (Outer Continental Shelf) exploration and development, 1985. Social and economic studies program technical report Number 115. Final report.** Berman, M.; Colt, S.; Hull, T. (Alaska Univ., Anchorage (USA). Inst. of Social and Economic Research). Jun 1985. 178p. NTIS, PC A09/MF A01.

See also PB—85-173409.

The report projects cumulative demographic and economic effects expected from the Federal Outer Continental Shelf (OCS) oil and gas lease sale program in Alaska. Econometric modeling techniques are used to develop projections including and excluding OCS exploration and development for the state of Alaska and the state's Southcentral Region. The projected cumulative effects of the OCS program include an increase of approximately 3.5% in state population and employment and a modest decline in real per capita state expenditures. The statewide employment and population effects grow as OCS development proceeds but diminish very slowly as construction employment declines the late 1990. The effects grow more slowly in the Southcentral Region.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 45261

44977 **(DOE/BC—86/3) Contracts for field projects and supporting research on enhanced oil recovery: Progress review No. 47, Quarter ending June 1986.** (USDOE Bartlesville Project Office, OK). Jul 1987. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87001206.

Progress reports are presented for field projects and supporting research for the following: chemical flooding; gas displacement; thermal recovery; resource assessment; environmental technology; and microbial technology. (AT)

44978 (IMechE—1987-4, pp 5-14) **Bulk inert gas generation - a practical solution to enhanced oil recovery in the North Sea.** Horton, A.; Griffiths, J.; Beck, K.E.; Weis, W. (Humphreys and Glasgow Ltd., London, UK; MAN-Gutehoffnungshuette GmbH, Oberhausen, DE). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

Enhanced Oil Recovery from offshore fields in the North Sea can be achieved through the injection of large quantities of gas. The conceptual development of a bulk gas process and the influence of turbomachinery design on the final process solution are discussed.

44979 (IMechE—1987-4, pp 59-66) **Hydraulic performance testing of centrifugal compressors -hydrocarbon versus inert gas.** Colby, G.M. (Dresser Industries Inc., New York, US). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

For many years, hydraulic performance parameters of centrifugal compressors have been demonstrated by 'in-shop' testing under the guidelines set forth by the ASME Power Test Codes. Variations between shop performance tests, and field performance tests have raised questions concerning the validity of the low pressure inert gas testing conducted by the manufacturer. Consequently, the user has requested the manufacturer to demonstrate the performance parameters, under actual operating conditions, by conducting an in-house performance test utilizing a uniquely blended hydrocarbon gas medium to meet true Class I and Class III testing of a centrifugal compressor at the manufacturer's facility. When correct thermodynamic gas properties are utilized and test tolerances sufficiently narrowed, correlation between Class I and Class III test results can be achieved. Allowable test tolerances are discussed and recommended test tolerances and criteria are presented.

44980 (IMechE—1987-4, pp 137-146) **Water injection - onshore/offshore.** Palgrave, R. (Ingersoll Rand Ltd., Gateshead, GB). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

Secondary recovery using high pressure multistage injection pumps is frequently employed in both offshore and onshore oilfields. The design philosophy of pumping machinery used in these applications differ in certain areas. This is largely dictated by the different environments. These design differences are compared and contrasted by way of a number of recent case studies. Future developments are also considered.

44981 **(LA-UR—87-878) A new method for determining fluid flow paths during hydraulic fracturing.** Fehler, M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-871012—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007489.

From 57. annual international meeting and exposition of the Society of Exploration Geophysicists; New Orleans, LA, USA (11 Oct 1987).

Although hydraulic fracturing is a popular method for increasing the productivity of oil and gas wells, there is no direct way other than drilling additional boreholes to determine where the injected fluid has gone and thus what direction a fracture has propagated. Information about fluid flow paths is important for designing subsequent fracturing operations for nearby wells. Determining the locations and orientations of permeable fractures is also important in studies of potential toxic waste repositories where it is critical to understand fluid flow paths. We have developed a method for determining the orientations and locations of fractures along which fluid flows during hydraulic fracturing. The method is based on accurate determination of the locations of microseismic events, or microearthquakes, that accompany the hydraulic injection. By applying a pattern recognition technique to the locations of events from one hydraulic fracturing operation we find planes in the data along which we presume that the fluid has traveled. The planes determined using our method intersect the injection borehole and a second, nearby borehole, in regions where other data indicate that fractures are present.

44982 **(NP—7900962) Managing oil and gas operations on the Outer Continental Shelf.** (Minerals Management Service, Washington, DC (USA)). 30 Sep 1986. 68p. Offshore Minerals Management, MS 646, Minerals Management Service, Washington, DC 20240. File Number TI87900962.

This publication focuses on the activities of the Department of the Interior, specifically the oil and gas operations program of the Minerals Management Service.

44983 **Sharp and diffuse fronts in oil reservoirs: Front tracking and capillarity.** Glimm, J.; Lindquist, B.; Mc Bryan, O.; Tryggvason, G. (Courant Institute of Mathematical Sciences, New York Univ., New York, NY 10012). pp 54-67 of Mathematical and computational methods in seismic exploration and reservoir modeling. Fitzgibbon, W.E. Philadelphia, PA; Society for Industrial and Applied Mathematics (1986). (CONF-850178—).

From Mathematical and computational methods in seismic exploration and reservoir modeling; Houston, TX, USA (21 Jan 1985).

A fingering interface instability occurs in laboratory studies of flow in oil reservoirs. The phenomenon has been captured numerically in a series of papers by the authors and co-workers. The

solution of a 20 year old problem is the latest in this line of work, and is discussed.

0204 Processing

REFER ALSO TO CITATION(S) 44864, 44868, 44910

0205 Products And By-products

REFER ALSO TO CITATION(S) 45691

44984 **(AD-A—181617/2/XAB) Development of new procedures for rating the ignition quality of fuels for diesel engines. Interim report, October 1984-October 1986.** Ryan, T.W. (Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility). Dec 1986. 130p. (BFLRF—223). NTIS, PC A07/MF A01.

The ignition delay times of 42 different fuels were measured in a constant-volume combustion bomb. The measurements were performed at three different initial air temperatures using fuels ranging from the primary reference fuels for cetane rating to complex mixtures of coal-derived liquids. A single-cylinder, variable compression-ratio, direct-injection diesel engine was designed and constructed to study the ignition quality of 17 of the 42 fuels. The total ignition delay times in the bomb were studied in the context of providing a means for rating the ignition quality of the fuels. Fuel-ignition-quality rating schemes are discussed, including one based on the current cetane-number scale as well as one based on a new scale which includes a measure of the sensitivity of the various fuels to the air temperature. The ignition delay times in the engine were measured as functions of the engine speed, load, and compression rato.

44985 **(PB—87-212346/XAB) Survey of vendors of external petroleum-leak -monitoring devices for use with underground storage tanks. Project report.** Eklund, B.; Crow, W. (Radian Corp., Austin, TX (USA)). Mar 1987. 149p. NTIS, PC A07/MF A01.

Underground storage tanks (UST's) and their associated piping are major potential sources of environmental contamination. Since the 1984 Amendments to the Resource Recovery and Conservation Act (RCRA) require regulation of underground storage tank systems. the U.S. Environmental Protection Agency (EPA) is currently investigating topics related to UST's to aid in developing regulations. EPA has contracted with the Radian Corporation to compile information on the various types of external (out-of-tank) monitoring systems or techniques which can be used to detect leaks or spills of petroleum hydrocarbon products. The compiled data were used to categorize external petroleum-leak monitoring devices or techniques by functions and type, and the data will aid in the future development of uniform performance criteria for commercially available external leak-monitoring methods. This study, which is limited to external (outside-the-tank) petroleum-leak-monitoring devices, supports the EPA effort by providing information on the number, type, and performance capabilities of available leak monitors. The literature was searched to collect general information on external petroleum leak monitors and, more specifically, to develop a list of vendors. Additional information was collected from equipment vendors, trade groups, and other researchers.

0206 Health And Safety

REFER ALSO TO CITATION(S) 45886, 46051

44986 **(PB—87-199493/XAB) Health experience of workers in the petroleum manufacturing and distribution industry.** Harrington, J.M. (Concawe, The Hague (Netherlands)). 1987. 53p. (CONCAWE—2/87). NTIS, PC PC E04/MF E01.

A review of over one hundred papers on the health effects of workers engaged in the manufacture and distribution of gasoline revealed inconsistent results. This may, in part, be due to the variable quality of the epidemiological studies. There is, however, the consistent finding of a deficit for all causes mortality and for all cancers mortality, thus implying that a widespread serious health effect of gasoline exposure seems remote. The evidence for a link between occupation and health effects is weak; however, the possibility exists that occupational etiological factors may play a part in the pathogenesis of brain cancer and renal disease. Further work of better quality is necessary to investigate those diseases where there remains a suspicion of an occupational etiology.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 45564, 45572, 45576, 45577, 45579, 45580, 45581, 45582, 45583, 45587

44987 **(CONF-8703159—1) The formation of conditional expectations: Application to the world oil market.** Hanson, D.A.; Boyd, G.A.; Hochheiser, H.W. (Argonne National Lab., IL (USA); USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Planning and Environment). Mar 1987. Contract W-31109-ENG-38. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011514.

From 13. annual convention of the Eastern Economic Association; Washington, DC, USA (5 Mar 1987).

This paper draws on an application to the world oil market and US domestic supply/demand for oil and substitute forms of energy. The example here is motivated by the recent National Petroleum Council (NPC) study on the outlook for US oil and gas supply/demand. The NPC Committee received about 30 responses from industry, utility, government, consulting and financial community representatives (see Oil and Gas Journal, Sept. 24, 1986). The survey elicited responses on the world oil market outlook conditional on two refinery oil acquisition price trends. The upper price trend starts at $18/bbl in 1986 and has real price growth of 5%/yr, reaching $36/bbl in year 2000. The lower price trend starts at $12/bbl in 1986 and has a 4%/yr real growth, reaching $21/bbl in year 2000.

44988 **(DOE/EI/19720—T1) Prices/stocks of No. 2 heating oil, State of Oregon, 1985-1986: End of survey report.** (Oregon State Dept. of Energy, Salem (USA)). 1986. Contract FC01-85EI19720. 19p. NTIS, PC A02. File Number DE87012035.

Residential and Rack prices for number two (No. 2 Diesel) Heating Oil and Stock-in-Inventory data were collected from 1 October 1985 through 5 May 1986 in accordance with the contract schedule. A one time survey was conducted to determine discount prices for cash or early payment given by dealers. This information was randomly reconfirmed throughout the period of the regular survey. No other data were collected on a regular basis during the course of this survey. However, additional information dealing with respondent dealership problems, shifts in ownership, and major oil company policies was gathered and passed on with the submitted reports, or was provided to other authorized recipients when requested.

44989 **(DOE/EI/19721—T1) Distillate fuel oil survey: Final report, 1986-1987.** (New Hampshire Governor's Energy Office, Concord (USA)). 1987. Contract FC01-85EI19721. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011847.

In the 1986-1987 heating season, the New Hampshire Governor's Energy Office continued the fuel price survey program first begun in 1976. The survey is conducted on a monthly basis throughout the year. Thirty-nine fuel oil dealers are asked the full service, credit price of their number two home heating oil, the amount of discount they give for immediate cash payment, and their inventory level.

44990 **(DOE/EIA—0035-87/05) Monthly energy review, May 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). May 1987. 137p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87014540.

Current data is presented on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on internation-

al production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities.

44991 **(DOE/EIA—0340(86)2) Petroleum supply annual, June 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 15 Jun 1987. 449p. NTIS, PC A19/MF A01 - GPO; 1; GPO Dep. File Number DE87010963.

Statistical data are presented. (PSB)

44992 **(DOE/EIA—0380(87/05)) Petroleum marketing monthly, May 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Jul 1987. 155p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. File Number DE87013449.

Information and statistical data about a variety of crude oils and refined petroleum products is given. Crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers are provided. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

44993 **(NP—7900960) Quarterly oil report: First quarter, 1987.** (California Energy Resources Conservation and Development Commission, Sacramento (USA). Assessment Div.). Jun 1987. 59p. California Energy Comm., 1516 Ninth St. MS 23, Sacramento, CA 95814. File Number TI87900960.

Market activity data include refinery operations, imports and exports, petroleum fuels stocks, sales and prices, as well as production. (PSB)

44994 **(OIES-WPM—6) Are oil price movements perverse. A critical explanation of oil price levels 1950-1985.** Stournaras, Y. (Oxford Institute for Energy Studies (UK)). 1985. 65p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Analytical explanations for the price trends and the important oil market episodes of the past three decades are presented. The main features of oil price movements between 1950 and 1984 are summarized. An attempt is made to explain why the real price of oil was falling from 1950 to 1970, and oil prices in the post-1970 period are examined. Two alternative hypotheses considered are that the reversal of the oil price trend in 1970 was the result of OPEC's cartelization of the oil market, and that this reversal was due to the underlying (dynamic) competitive forces and a number of market failures other than cartelization. An explanation of the oil price movements is provided.

44995 **(PB—87-207205/XAB) Sub-Arctic deep-water petroleum technology assessment. Social and Economic studies program technical report Number 109. Final report.** (Brown and Root Development, Inc., Houston, TX (USA)). Jun 1984. 212p. NTIS, PC A10/MF A01.

The report reviewed and assessed the current technology and component costs feasible for exploration, production, and transportation of oil resource in water depths beyond 200 meters in the study regions. An additional requirement was to provide a basis for analyzing the economic and financial viewpoints. The basis is presented in a building block format which can be updated and refined as technology advancements are realized. Within the current state of the art, costs for development beyond water depths of 1000 meters should be considered somewhat academic for ice-free areas such as the Gulf of Alaska. Developments in the Bering Sea are feasible to about 300 meters.

0208 Waste Management

REFER ALSO TO CITATION(S) 44910, 44912, 44915

44996 **(EPRI-CS—5261) Remedial technologies for leaking underground storage tanks: Final report.** (Weston (Roy F.), Inc., Concord, CA (USA); Massachusetts Univ., Amherst (USA). Environmental Science Program; Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 239p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920510.

This report is the result of a cooperative effort between the Electric Power Research Institute (EPRI) and the Leaking Underground Storage Tank Committee of the Utility Solid Waste Activities Group (USWAG). It presents a description and evaluation of available technologies for remediating soil and groundwater that contain petroleum products released from underground storage tank leaks, other discharges, or spills.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 44864, 44915, 44996, 46312, 46313, 46314, 46315, 46333

44997 **(PB—87-194932/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 46.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jul 1986. 650p. NTIS, PC A99/MF A01.

See also PB—87-192266 and PB—87-194940 through PB—87-194965.

Contents include: Source, composition, and flux of organic detritus in lower Cook Inlet; Lower Cook Inlet meroplankton; Seasonal population density distribution of copepods, euphausiids, amphipods, and other holoplankton on the Kodiak Shelf.

44998 **(PB—87-194940/XAB) Source, composition, and flux of organic detritus in lower Cook Inlet. Final report.** Larrance, J.D.; Chester, A.J. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jul 1979. 65p. NTIS, PC A99/MF A01).

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 46, 1-71(Jul 1986).

A series of sediment trap deployments was combined with intensive water-column sampling to obtain measurements of the production and input of organic detritus to the sea floor in relation to the bio-physical environments of lower Cook Inlet. The samples provided measurements of downward fluxes of total particulate matter; organic carbon and nitrogen; chlorophyll a and pheophorbide a; fecal pellets; and other microscopically identifiable particles including phytoplankton cells, crustacean molts, and microzooplankton. Comparisons of organic carbon and nitrogen content of the sediment-trap samples among the three sampling locations generally reflected the primary productivity in overlying waters. These results indicate the transfer of substantial organic matter from surface waters to the benthos, much of it via zooplankton fecal pellets. Such particles, if contaminated with oil, act as transfer agents for oil from the surface thus impacting the benthic community.

44999 **(PB—87-194957/XAB) Lower Cook inlet meroplankton. Final report.** English, T.S. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Oct 1979. 349p. NTIS, PC A99/MF A01.

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 46, 73-422(Jul 1986).

The study is a contribution to the understanding of quanititative seasonal changes of eggs and larvae of fishes and shellfishes of major economic significance in Lower Cook Inlet. Early-life-history stages of importannt components of the food webs of Lower Cook Inlet, Kachemak Bay, and Kamishak Bay have been identified. Temporal and spatial dynamics and distributions of important ecosystem components, the ichthyoplankters and meroplanktonic

stages of shrimps and crabs, have been tabulated, depicted, and described. Timing and use of specific areas within Lower Cook Inlet by early-life-history stages of fishes, shrimps, and crabs have been tabulated, depicted, and evaluated.

45000 **(PB—87-194973/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 47.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Nov 1986. 622p. NTIS, PC A99/MF A01.

See also PB—87-194932 and PB—87-194981 through PB—87-195012.

Contents include: Erosion, deposition, faulting, and instability of shelf sediments: eastern Gulf of Alaska; Seafloor geology and geologic hazards in the eastern Gulf of Alaska; Geology of the Alsek sediment instability study area; Taxonomy, ecology, andd zoogeography of the Holocene and Pleistocene ostracode fauna of the Gulf of Alaska.

45001 **(PB—87-195012/XAB) Erosion, deposition, faulting, and instability of shelf sediments: eastern Gulf of Alaska. Section 3. The taxonomy, ecology, and zoogeography of the Holocene and Pleistocene ostracode fauna of the Gulf of Alaska. Final report.** Brouwers, E.M.; Molnia, B.F. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Mar 1982. 577p. NTIS, PC A99/MF A01.

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 47, 57-638(Nov 1986).

The primary goal of the study has been to provide pertinent information on the age, environment, and sediment transport of continental-shelf sediments of the northeast Gulf of Alaska based on the ostracode assemblages. In addition, these studies provide information tabulating the ostracode species present as well as associated faunal and floral elements. These data on the patterns of distribution and abundance of benthic organisms provide a baseline prior to the development of oil and gas leases on the continental shelf of the Gulf of Alaska.

45002 **(PB—87-195160/XAB) Distribution of larval and juvenile red king crabs (Paralithodes camtschatica) in Bristol Bay. Final report.** McMurray, G.; Vogel, A.H.; Fishman, P.A.; Armstrong, D.A.; Jewett, S.C. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Feb 1984. 210p. NTIS, PC A99/MF E04.

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 53, 267-477(Dec 1986).

The goal of the present study is to provide sufficient information on larval and juvenile red king crab distributions and associated environmental variables to reasonably describe the potential effects of oil and gas development on the crab population and its fishery in Bristol Bay.

45003 **(PB—87-198867/XAB) Outer Continental shelf environmental assessment program. Final reports of principal investigators. Volume 51.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Dec 1986. 787p. NTIS, PC A99/MF E04.

See also PB—87-195951 and PB—87-198875 through PB—87-198925.

The following are repoted: research to determine the accumulation of organic constituents and heavy metals from petroleum-impacted sediments by marine detritivores of the Alaskan outer continental shelf; Suspended particulate matter distribution, transport, and physical characteristics in the north Aleutian Shelf and St. George Basin lease areas; The production and dispersion of dissolved methane in southeastern Bering Sea; Oil spill vulnerability, coastal morphology, and sedimentation of outer Kenai Peninsula and Montague Island; Circulation and water masses in the Gulf of Alaska; Coastal oceanography of the northeastern Gulf of Alaska.

45004 **(PB—87-198891/XAB) Production and dispersion of dissolved methane in southeastern Bering Sea. Final report.** Cline, J.D.; Kelly-Hansen, K.; Katz, C.N. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). 1982. 106p. NTIS, PC A99/MF E04.

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 51, 309-417(Dec 1986).

The purpose of the study was to use dissolved methane as a tracer of mean circulation and to define vertical and horizontal mixing scales in local regions of the southeastern Bering Sea. The subregions selected for study included St. George Basin, a fault basin located on the outer shelf of Bristol Bay, and the North Aleutian Shelf. Both regions were identified as potential off-shore leasing sites for gas and oil production.

45005 **(PB—87-198909/XAB) Oil spill vulnerability, coastal morphology, and sedimentation of outer Kenai Peninsula and Montague Island. Final report.** Hayes, M.O. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Apr 1980. 536p. NTIS, PC A99/MF E04.

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 51, 419-538(Dec 1986).

The report discusses the results of an extensive study of the geomorphology, sedimentology, and oil-spill vulnerability of the outer Kenai Peninsula and Montague Island shorelines. Major emphasis is placed on the application of an Oil Spill Vulnerability Index (O.S.V.I.). Large segments of the shoreline are high risk environments with respect to oil-spill residence time. Nearly 60% of the study area falls into O.S.V.I. classes 6-10, which indicates any oil spilled would have residence times from one to more than ten years.

45006 **(PB—87-205944/XAB) Health-hazard evaluation report HETA 86-132-1780, Alyeska Pipeline Service Company, Valdez, Alaska.** Apol, A.G.; Singal, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 25p. (HETA—86-132-1780). NTIS, PC A02/MF A01.

A study was made of employee exposure to oil sludge and vapors during oil-sludge removal and maintenance activities at the Alyeska Pipeline Service Company's Ballast Water Treatment Facility, Valdez, Alaska. Total hydrocarbons, except benzene, toluene, and xylene, showed concentrations from 371 to 1228mg/m3. Of eight maintenance workers, five reported headache, dizziness, or nausea when working without a respirator. The authors conclude that workers were potentially exposed to benzene vapors and total hydrocarbon vapors exceeding the evaluation criteria for these substances. The authors recommend the use of respiratory protection measures to reduce exposures during work operations.

0230 Properties

REFER ALSO TO CITATION(S) 44868

45007 **(VTT-TIED—663) Boundary lubrication. Experiments with boundary lubrication and plain bearings at +60...-60 deg C temperatures.** Koponen, P.; Kytoe, M.; Kuusisto, E.; Yloestalo, O. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1987. 71p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752869.

Boundary lubrication properties of different hydraulic oils and industrial transmission oils were compared. The lubricants consisted mainly of two mineral base oils (viscosity classes ISO VG 32 and ISO VG 150), with different wear inhibitors. Vegetable oils with and without additives, synthetic polyalphaolefins and synthetic esters were also used as lubricants. The wear inhibition and friction of about 20 test oils were measured both on standard test equipment and on two modified plain bearing benches. One of the plain bearing benches operated in cold conditions, in the temperature range from +20 to -60 deg C. The function of additives was also studied by monitoring the test specimens of the plain bearing experiments in a SEM microscope. The significance of additives was clearly verified in the boundary lubrication experiments. The differences between the various additives were in most cases small at the lowest loads. In more severe conditions all additives did no longer prevent from wearing. There were also differences between the base oils. The rapidly reacting additives were more effective in short-term experiments in severe conditions. Different zinc ditio-

phosphates and sulphur phosphorus compounds are most general wear inhibitors and high-pressure additives. The analyses made with the SEM microscope gave no proof of the operation of additives in cold conditions (0-60 deg C). However. the test results give indications of the operability of additives in cold conditions. A sufficiently high local temperature is said to be a prerequisite for the start of the preventive reactions of additives. In the short-term standard experiments, the wear inhibition properties of lubricants differed from each other only in extreme conditions. In the plain bearing experiments the conditions were closer to conditions in practice, whilst the boundary lubrication properties of lubricants had to be studied primarily on the basis of friction properties.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 44968, 44969, 44970, 44971, 44972, 44973, 44974, 44975, 44976, 46341

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 44982, 45011

45008 (IMechE—1987-4, pp 67-75) **Design, testing and commissioning of the reinjection centrifugal compressors for the Alrar gas treatment plant.** Wyssmann, H.; Lorenzen, J.; Pluess, F. (Sulzer-Escher Wyss Ltd., Zurich, CH). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

The Alrar field in South East of Algeria is a gasfield with a high content of condensates. The NGL-plant is one of the largest in Algeria. Sulzer supplied all the process, booster and reinjection compressors. The mechanical design and the extensive testing of the high pressure train in the works are described covering aerodynamic performance, rotor stability and shaker testing with high mol weight gases in order to demonstrate mechanical behaviour of the solid coupling and gearbox with thrust collar system. During full load testing, new concepts for improving rotor stability have been evaluated. Solutions to commissioning problems connected with excessive pipe forces and auxiliary systems are described.

0305 Health And Safety

REFER ALSO TO CITATION(S) 46051

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 45560, 45573

0307 Waste Management

45009 **(PB—87-208831/XAB) Stretford process status and R and D needs. Topical report.** Trofe, T.W.; Dalrymple, D.A.; Scheffel, F.A. (Radian Corp., Austin, TX (USA)). Feb 1987. 318p. (DCN—87-218-043-16). NTIS, PC A14/MF A01.

The Stretford process is a liquid-phase oxidation/reduction process which removes H_2S from gaseous streams and produces either elemental sulfur for sale or a sulfur cake, a waste which is commonly landfilled. Many users have expressed a need for more information to improve current and potential future applications. The document summarizes findings from an extensive search of public literature, as well as some findings of the research initiated in response to needs which were identified when this information was first compiled in mid-1985. Vendor and user inputs are also incorporated where available. Included are extensive discussions of process chemistry, process design and operation, environmental, health and safety factors, and research needs and activities. A listing of all known Stretford plants, both operating and shutdown, is also included.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 44997, 44998, 44999, 45000, 45001, 45002, 45003, 45004, 45005, 46333

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 44981

45010 **(PB—87-207155/XAB) Acoustic and dielectric properties and network models of tight-gas sandstones. Annual report, July 1985-June 1986.** Nur, A. (Stanford Univ., CA (USA). Dept. of Geophysics). Jul 1986. 65p. NTIS, PC A04/MF A01.

See also PB—86-132834.

Nuclear magnetic resonance (NMR) data were inverted to obtain the surface area to volume ratio (S/V) of the pore space of a sandstone. The variation of S/V with water saturation (Sw) shows the increasing importance of surface effects as Sw decreases. Ultrasonic compressional and shear velocities were measured as functions of differential pressure to 50 MPa and Sw on 80 sandstone samples with porosity ranging from 0.02 to 0.50 and volume clay ranging from 0.0 to 0.50. Vp and Vs for clean sandstones exhibit a linear dependence on porosity. Vp and Vs data for sandstones containing clay are noticeably distinct from those for clean sandstones and show a linear dependence on porosity and clay content. The presence of water causes a decrease in the shear and bulk moduli and consolidated shaly sandstones, but an increase in these moduli in unconsolidated shaly sandstones. An apparatus was built to measure complex shear and compressional moduli of rocks over the frequency range of 5 kHz to 1 MHz. Data collected using a sample of Vycor porous glass show effects due to geometrical dispersion and due to frequency-dependent moduli. The low-velocity and large-moduli dispersion at frequencies below 100 KHz are interpreted as due to the influence of adsorbed water films.

0320 Transport, Pipelines, And Handling

45011 (IMechE—1987-4, pp 53-57) **Applications of dry gas seals to gas export compressors in the North Sea.** Dorey, R.C.; Ashmore, T.R. (Crane Packing Ltd., Slough, GB; Amoco UK Exploration Co., Bacton, Norfolk, GB). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

The experience of Crane Packing Ltd. and Amoco (UK) Exploration Co. in retrofitting gas seals to a natural gas compressor is discussed. Some of the practical benefits are outlined and the extensive testwork carried out to meet the stringent reliability requirement for successful offshore operation is highlighted. A comparison of actual and perceived advantages over the more standard liquid seal arrangements is also discussed.

45012 (IMechE—1987-4, pp 105-116) **Simulation of the transient performance of a compressor in a natural gas pumping station.** Elder, R.L.; Gill, M.E.; Razak, A.M.Y. (Cranfield Inst. of Tech., Bedford, UK). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

The design of compressor and fan systems requires a knowledge of the dynamic interaction between components of the system if aerodynamically stable operation is to be achieved over a range of operating conditions. A mathematical model, based on a one dimensional representation of the dynamic conservation equations has been developed to simulate the transient performance of a compression system. Application of the model to a natural gas pumping station is described, demonstrating the use of the model as an aid in component specification or failure investigation.

0330 Properties

REFER ALSO TO CITATION(S) 44868

45013 **(PB—87-209417/XAB) Molecular theory and computer-simulation studies of natural and synthetic gas mixtures. Final report, January 1, 1983-December 31, 1986.** Gubbins, K.E. (Cornell Univ., Ithaca, NY (USA). School of Chemical Engineering). Jan 1987. 44p. NTIS, PC A03/MF A01.

See also PB—86-203262.

Studies of bulk fluid mixtures and of liquid surface properties (liquid-gas and liquid-liquid) by statistical mechanical theories and computer simulation are reported. The authors have developed new theoretical equations of state for mixtures in which the molecules may be polar, polarizable, or associated. In cases where association or hydrogen-bonding occurs, the authors have undertaken a study of mixtures in which the unlike molecules associate strongly. The theoretical equation of state is in excellent agreement with the Monte Carlo simulation results, even for the complete dimerization limit. Comparisons of the theory with experimental data are also promising and offer a distinct improvement over existing equations when association occurs. The authors have also developed new theoretical equations of state for electrolyte solutions, and have made simulation calculations to test them. The work on adsorption at liquid-vapor and liquid-liquid interfaces has been extended to study surfactant molecules that are polar and of nonspherical shape. Studies based on mean field theory and molecular dynamics simulation are aimed at examining the effects of varying the molecular characteristics.

45014 **(PB—87-209987/XAB) Development of an equation of state for computation of supercompressibility factors, critical flow factors, and other properties for wet, sour natural gases, sythetic gases and admixtures. Annual report, October 1985-September 1986.** Starling, K.E.; Savidge, J.L.; Shankar, S.; Reid, T. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). Sep 1986. 15p. NTIS, PC A02/MF A01.

See also PB—86-196185.

The equation of state developed for sweet/dry natural gases was used to predict the sonic velocity of pure methane and other pure systems for which data exist. In the region of interest to sonic-nozzle calculations, excellent agreement was obtained between pure methane experimental sonic velocities and the calculated sound speeds from the equation of state with agreement often better than 0.05%. At low temperatures (less than 250K) and pressures near the critical pressure of methane, significant differences between calculated sonic velocities and experimental sound speeds were found. This suggests the equation of state could be improved, if deemed necessary, for this region. To date, accurate speed of sound measurements for actual natural gas mixtures have not been made. This severely limits testing the equation of state beyond the limited amount of pure-component data until mixture data become available. A computer program was developed to predict all the important properties used in sonic-nozzle calculations.

0340 Combustion

45015 **(PB—87-213153/XAB) Basic research on natural gas combustion phenomena--catalytic combustion. Annual report 1986. Report for 15 January 1986-14 January 1987.** Quinlan, M.; Wise, H.; McCarty, J. (SRI International, Menlo Park, CA (USA)). Mar 1987. 77p. NTIS, PC A05/MF A01.

The intrinsic activity of a series of lanthanum perovskite catalysts for catalytic methane oxidation was determined by temperature-programmed reaction and stationary-state order of reaction experiments. The catalysts were prepared by conventional precipitation of nitrate salts, calcined in oxygen, and characterized by x-ray diffraction, BET surface area, and temperature-programmed evolution of oxygen. The rates of catalytic methane oxidation were first order in methane partial pressure and half-order in oxygen partial pressure. The kinetic studies suggested that methane oxidation occurred in two parallel reaction paths over different active centers. The greatest influence on the performance of the perovskite catalysts was loss of surface area by sintering at elevated temperature. When normalized to surface area, the activity of the first-row transition-metal lanthanates increased in the order $LaCrO_3$ < $LaFeO_3$ < $LaMnO_3$ < $LaCoO_3$ < $LaNiO_3$ which inversely correlates with their phase stability. Changes in metal oxide stoichiometry, increased oxygen anion vacancy concentration, and changes in the transition-metal cation valence state had lesser influence on combustion activity.

0350 Storage

45016 **(LBL—23500) Feasibility analysis and development of a foam-protected underground natural gas storage facility.** Witherspoon, P.A.; Shikari, Y.; Radke, C.J.; Pruess, K.; Persoff, P.; Benson, S.M.; Wu, Y.S. (California Univ., Berkeley (USA); Gas Research Inst., Chicago, IL (USA); Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 35p. (CONF-8705164—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012030.

From Distribution/transmission conference; Las Vegas, NV, USA (4 May 1987).

Underground storage of natural gas has been practiced for over 40 years as a cost effective means of meeting peak demand. However, the volume of gas that must remain in the storage aquifer (base gas) is typically large compared to the quantity that is available for withdrawal (working gas). One way of improving the efficiency of gas storage operations is to keep the working gas closer to the withdrawal wells, and to create a thicker gas saturated region. To achieve this, the mobility of the injected gas must be controlled. We are investigating the feasibility of using foam as a mobility control agent for gas storage operations. Specific concepts for using foam to improve gas storage operations range from improved injection/withdrawal well performance to the potential for creating isolated underground storage regions. This paper describes the efforts of the first year of a three-year research program that is being sponsored by the Gas Research Institute. Laboratory studies for identifying suitable foams and for improving our knowledge of foam behavior are being carried out. In addition, a mathematical model for simulating "foam-protected" gas storage operations and for designing "foam-protected" storage operations is being developed. Preliminary economic analyses indicate a significant reduction in gas storage costs in a successfully implemented "foam-protected" aquifer gas storage operation. 23 refs., 12 figs., 3 tabs.

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 45055

45017 (DOE/FE/60177—2305-Vol.1, pp 119-123) **Major tar sand deposits of Utah, United States: recent field investigations.** Oliver, R.L. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The estimated total tar sand resource of the US is 54 billion barrels. Utah contains 37% of the total estimated resource and 55% of the measured resource. Three of the more significant deposits have been studied to identify resources and to evaluate characteristics related to development. These three deposits are PR Spring, Northwest Asphalt Ridge, and the Tar Sand Triangle. The objective of this research was to define the size and nature of the tar sand resource by supporting continued development of a unified, comprehensive, and integrated data base incorporating all available tar sand deposit characteristics. This task was accomplished by the categorization of high priority US tar sand resources relative to their reservoir properties, extraction process options, and developmental considerations.

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 45018, 45069

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 44827, 44864, 44868, 45043, 45044, 45052, 45069, 45070, 45821

45018 (DOE/FE/60177—2305-Vol.1, pp 18-22) **Results of experiments on compaction of oil shale during retorting.** Fahy, L.J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

A series of experiments was conducted to study oil shale compaction during retorting. The objectives of the first nine experiments were to determine the effects of particle size, to measure compaction of different shale grades with 12 to 25% void volume, and to study the effects of heating rate on compaction. Subsequent experiments studied the effects of pressure, mineral decomposition, and a wide particle size distribution.

45019 (DOE/FE/60177—2305-Vol.1, pp 22-27) **Retorting oil shale rubble with permeability contrasts.** Merriam, N.W. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objectives of this study were to characterize permeability contrasts in nonuniform rubble beds and correlate results with experimental oil yields; predict oil yields from nonuniform rubble beds in advance of retorting operations; and test the use of external fuel to improve yields of shale oil from nonuniform rubble beds.

45020 (DOE/FE/60177—2305-Vol.1, pp 27-29) **Horizontal low-void retorting of eastern and western oil shale.** Fahy, L.J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objectives of this study were to simulate the horizontal retorting process in the laboratory and to determine oil yield, retorting zone profiles, and product characteristics when alternative operating conditions were used for eastern and western oil shales.

45021 (DOE/FE/60177—2305-Vol.1, pp 30-33) **Combustion retorting of oil shale at low-void volumes.** Fahy, L.J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

In situ retorting of oil shale typically occurs under low-void volume conditions. In order to operate in situ retorts efficiently and economically, a good understanding of the physical processes that occur is needed to optimize construction and operation. Pilot-scale experiments conducted in a low-void retort can provide information that is useful for improving the design and operation of commercial-sized in situ retorts. The objective of this study was to conduct a series of experiments in the WRI low-void retort to develop a data base for design and definition of operating conditions at pilot scale. This information should be useful for extrapolation to commercial in situ retorts.

45022 (DOE/FE/60177—2305-Vol.1, pp 33-35) **Radio-frequency heating of oil shale blocks.** Merriam, N.W. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Radio-frequency (RF) electromagnetic energy heats materials without using external thermal gradients. The dielectric properties of oil shale are suitable for RF heating. Water and similar polar molecules in oil shale convert RF energy to heat very readily, while the RF energy passes through the other materials in the oil shale with negligible energy conversion. The primary objective of this research was to develop methods applying RF energy to oil shale processes that would increase oil yields and improve the quality of shale oil. To this end, the immediate objectives of this research were to design and construct an experimental apparatus to evaluate a monopole as a means of applying RF energy to oil shale blocks, and to acquire experimental data for comparison with values calculated by an RF retorting model developed by the University of Wyoming.

45023 (DOE/FE/60177—2305-Vol.1, pp 35-38) **Supercritical fluid extraction of oil shale.** McKay, J.F. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objectives of the research were to explore supercritical fluid extraction as a method for recovering oil from shales in high yield and to obtain fundamental data defining the chemical nature of the organic matter in both western and eastern shales. The procedures and results of this research are discussed.

45024 (DOE/FE/60177—2305-Vol.1, pp 39-43) **Technical and economic feasibility of sulfur trioxide retorting of oil shale.** Johnson, L.A. Jr. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Sulfur trioxide (SO_3) is a potential novel alternative to combustion air for generating the process heat in oil shale retorting processes. By-product sulfur from the shale retorting and oil upgrading operations is easily converted to sulfur trioxide. The potential heat generation with sulfur trioxide is greater than conventional combustion reactions because the sulfur trioxide reacts exothermically not only with the organic carbon but also with carbonate minerals in the shale. The objective of this study was to evaluate the technical and economic feasibility of using sulfur trioxide for direct and indirect oil shale retorting. Major emphasis of the study was to examine oil production, oil quality, and heat production for retorting.

45025 (DOE/FE/60177—2305-Vol.1, pp 43-45) **Gas tracer analysis on oil shale rubble with permeability contrasts.** Turner, T.F. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The potential oil yield from an oil shale retort can be expressed as a product of the sweep efficiency, a measure of the overall retort uniformity, and the local yield, a measure of local retorting efficiency. Western Research Institute conducted nine pilot-scale oil shale retorting tests to determine the effects of nonuniform shale bed packing on oil yield and tracer responses. A tenth test, to study retorting an external fuel, was run later. The tracer tests were designed to provide data for the correlation of oil yield, sweep efficiency, and local yield with inlet-to-outlet tracer responses; to correlate permeabilities and oil yields with in-bed tracer responses; and to test the adequacy of a two-dimensional flow model for describing flow and tracer behavior in a nonuniform rubble bed.

45026 (DOE/FE/60177—2305-Vol.1, pp 49-53) **Modifications to a one-dimensional retorting model.** Schreiber, J.D. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

A mathematical model for oil shale retorting is an important tool for interpreting and guiding the design of experiments to simulate the operation of commercial retorts. A model also provides an inexpensive means for evaluating the performance of large-scale retorting processes. A transient, one-dimensional retorting model was developed in 1980 by Braun that describes the principal chemical reactions and heat and mass transfer processes that take place during retorting. Although Braun's model has been widely accepted and used, it neglects certain phenomena that are important in modified in situ and batch experimental retorts, namely, oil transport processes, effects of shale compaction, and wall heat losses. The objective of this research was to incorporate wall heat loss calculations, mechanisms for the transport of oil (including liquid-phase oil), variable gas pressure, and the effects of shale compaction into Braun's one-dimensional retorting model.

45027 (DOE/FE/60177—2305-Vol.1, pp 54-56) **Postburn evaluation of retort 1 at least tract C-a.** Trudell, L.G.; Sudduth, B.C. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Rio Blanco Oil Shale Company developed and operated retort 1 on Federal Prototype Oil Shale Tract C-a in Colorado's Piceance Creek Basin to determine the technical, economic, and environmental viability of their modified in situ (MIS) recovery process. Retort 1 was ignited in June 1981 and operated for six months. Subsequently the mine and retort filled with ground water that entered through the natural fracture system connecting the workings with an aquifer in the overburden. Because of a common interest in determining environmental effects and control requirements for abandonment of MIS retorts, the Department of Energy and Rio Blanco Oil Shale Company are cooperating in a postburn evaluation of retort 1.

45028 (DOE/FE/60177—2305-Vol.1, pp 126-132) **Comparison of recovery processes for Asphalt Ridge tar sand.** Romanowski, L.J. Jr. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Several in situ thermal processes have been evaluated for the recovery of oil from tar sand deposits. Steamflooding, reverse and forward combustion, steam-oxygen combustion and hot-gas pyrolysis were included in these bench-scale experiments. These processes add or generate heat to the reservoir. The increased temperature improves the mobility of the product oil through bitumen pyrolysis and viscosity reduction. In addition, these processes provide a driving force (pressure) to displace product oil toward the production wells. The purpose of this study was to evaluate various in situ thermal oil recovery processes applicable to tar sand from the Asphalt Ridge deposit. Steamflooding, reverse and forward combustion, steam-oxygen combustion and hot-gas pyrolysis are compared to determine the effects of the selected process on oil yield, product oil quality and process efficiency.

45029 (DOE/FE/60177—2305-Vol.1, pp 137-143) **Comparison of laboratory and field steamflood test results.** Johnson, L.A. Jr.; Romanowski, L.J. Jr. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objective of this study was to identify the process parameters for application of the steamflood process to the Asphalt Ridge tar sand resource and compare the results of the laboratory tests to those from a steamflood field test in the NW Asphalt Ridge tar sand resource. To meet this objective, a series of linear steam displacement simulations were conducted at varying injection rates and preheat temperatures on two grades of tar sand to identify the resource specific operational parameters. Based on the results of the linear experiments, a three-dimensional (3-D) steamflood simulation was conducted to verify parameters identified in the linear tests and to identify those parameters not realistically simulated in linear tests. Results of the test are discussed.

45030 (DOE/FE/60177—2305-Vol.1, pp 143-146) **Numerical model for thermal recovery processes in tar sand: description and application.** Vaughn, P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

A fundamental model for numerically simulating the in situ thermal recovery of oil from a tar sand resource has been developed. The model accounts for the three-phase flow of oil, water, and gas. Mass transfer among the phases and components is dictated by liquid and vapor equilibria, reaction kinetics, reservoir properties, and processing conditions. Energy is transferred by the mechanisms of conduction, convection, reaction kinetics, and by vaporization and condensation. The solution technique employed in the model is based on a method using the Newton-Raphson iteration scheme with a variable time-step algorithm. Results have been compared with results from another numerical simulator as well as with results from two forward combustion experiments conducted at WRI.

45031 (DOE/FE/60177—2305-Vol.1, pp 146-148) **Numerical simulation of four forward combustion tube experiments using the Tar Sand Triangle resource.** Vaughn, P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Two mathematical models were used to numerically simulate the thermal recovery of oil from tar sand in tube reactor tests conducted at Western Research Institute (WRI). The results from the two numerical models were compared with the results from four tube reactor forward combustion experiments in which the Tar Sand Triangle resource was used. Tar Sand Reservoir Simulator 1 (TSRS1) is a fundamental model for numerically simulating the in situ thermal recovery of oil from a tar sand resource. TSRS1 accounts for the three-phase flow of oil, water, and gas, and considers the combustion of bitumen, oil, and residual char as well as the pyrolysis of bitumen. The second numerical model, TSRS2 contains all of the features of TSRS1 plus an enhanced kinetic reaction module and an increased flexibility in specifying the number of chemical components. The primary objectives of this research were threefold: to simulate the four forward combustion, Tar Sand Triangle tube reactor experiments conducted at WRI using TSRS1 and the latest material property data; to develop TSRS2, an enhanced version of TSRS1, which is capable of accounting for additional reactions and chemical components; and to validate TSRS2 by comparisons with experimental results.

45032 (DOE/FE/60177—2305-Vol.1, pp 149-153) **Hot gas pyrolysis of tar sand.** Johnson, L.A. Jr.; Romanowski, L.J. Jr. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Several in situ thermal processes for the production of bitumen from tar sand have been studied. Steam-flooding and in situ combustion techniques have been tested with varying degrees of success. Hot-gas injection is an alternate thermal method which has

the potential to be either a principal production mechanisms or the means for establishing a preheated zone for a production process. The purpose of this study was to evaluate the injection of a hot inert gas into Utah tar sands. One-dimensional simulations were conducted to study the formation plugging caused by viscous oil banking, the effectiveness of hot-gas preheating before a subsequent steamflood, the thermal upgrading of the bitumen caused by distillation and pyrolysis, and the increase in oil recovery. Samples from Asphalt Ridge and Tar Sand Triangle resources were used in these tests. To further evaluate the hot-gas pyrolysis, a three-dimensional simulation was conducted on an Asphalt Ridge sample to study the heat transfer geometry and the bitumen distillation mechanism.

45033 (DOE/FE/60177—2305-Vol.1, pp 154-155) **Pyrolysis of Asphalt Ridge tar sand.** Turner, T.F. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The quantities and properties of the products from thermal processing of tar sand are dependent on the relative amounts of bitumen cracking and distillation. Therefore, the study of cracking kinetics is important to fully understand and utilize thermal processing of the resource. The cracking kinetics of the bitumen in tar sand has been studied by several researchers. These studies demonstrated that the sand in tar sand has a catalytic effect on bitumen pyrolysis. Few studies have been made on Utah tar sand even though much in situ and ex situ processing of the tar sand has been done. The specific objectives were to modify existing techniques and equipment to run isothermal pyrolysis experiments on the tar sand, to determine the average molecular weight and elemental composition of the produced oil, and to measure the amounts and time dependencies of gaseous, liquid and solid products. Other objectives were to develop appropriate computer programs for handling nonisothermal pyrolysis data and to calculate the values of the activation energy and pre-exponential factor for tar sand bitumen pyrolysis.

45034 (DOE/FE/60177—2305-Vol.1, pp 156-158) **Preliminary results of tar sand pyrolysis with product oil recycling.** Cha, C.Y. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The Western Research Institute is developing a new pyrolysis process called ROPE (Recycle Oil Pyrolysis and Extraction) for recovering products that require a minimum of upgrading to produce a finished, marketable fuel. The process consists of two pyrolysis steps: retorting tar sand at a lower temperature with the product oil recycling, and completing the pyrolysis of the residue at the higher temperature in the absence of product oil recycling. The overall objective of this research activity is to develop the ROPE process which gives much greater oil yield from tar sand than conventional processes and also possibly produces advanced fuel feedstocks and asphalt binders. The activities for 1986 were: to construct a 2-inch batch retort that can be used to simulate the ROPE process; to conduct preliminary experiments in the batch retort to obtain the product oil expected to be produced when the tar sand is retorted with the heavy oil; to determine the characteristics of oil products; to obtain parameters required for design of a bench-scale unit, and to design and construct the bench-scale unit.

45035 (DOE/FE/60177—2305-Vol.1, pp 159-160) **Oil yield loss diagnostics.** Guffey, F.D. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

A preliminary investigation was undertaken to explore the possibility of developing oil yield loss diagnostic methods for the thermal recovery of tar sand bitumen. This preliminary research effort was performed to address the following objectives: determine the amount of coke formed during the heat soaking tar sand at temperatures below pyrolysis (380 to 420°C or 716 to 788°F), and identify any chemical species in the produced liquids that relate to coke formation or the temperature used for thermally soaking the resource.

45036 (DOE/FE/60177—2305-Vol.1, pp 160-162) **Bonding energies of bitumen to tar sand mineral.** Ensley, E.K.; Scott, M.A. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

An important consideration in energy or fuel recovery from tar sand is the type of bond between the organic phase and the inorganic matrix. The only economically operating tar sand development is in Alberta, Canada where the tar sand is water-wet. The organic-wet tar sand deposits, such as these found in Utah, are more difficult to develop because of the strength of the bond between the organic material and the inorganic matrix. Elucidation of the type and strength of the bitumen-mineral bond in oil-wet sand could assist in commercialization of these presently intractable deposits. On this premise a study was initiated to investigate the bonding (or debonding) of an Asphalt-Ridge bitumen to the mineral matrix. The objective of the research was to measure the bond strength between the organic and inorganic phase of a tar sand bitumen. The data can be used to facilitate energy or bitumen recovery from tar sand.

45037 (DOE/FE/60177—2369) **Modeling of oil shale compaction during retorting.** Schreiber, J.D. (Western Research Inst., Laramie, WY (USA)). Jun 1986. Contract FC21-83FE60177. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012042.

A model of oil shale compacting during retorting has been developed and incorporated into a one-dimensional retorting model. The model calculates the vertical stress distribution in a column of oil shale rubble and the degree of compaction that these stresses cause. A correlation was developed that relates shale grade, initial void volume, and vertical stress to the final compaction of the shale bed. The model then determines the gas pressure drip through the retort and the effects of the varying pressure on the retorting process. The model has been tested by simulating the Rio Blanco Oil Shale Company's Tract C-a Retort 1. The model calculates 8.1% compaction, whereas 12 to 16 compaction was measured in the retort; causes of the discrepancy between calculated and measured values are discussed. 14 refs., 10 figs., 2 tabs.

45038 (DOE/FE/60177—2401) **Western Research Institute: Quarterly technical progress report, April-June 1986.** (Western Research Inst., Laramie, WY (USA)). Aug 1986. Contract FC21-83FE60177. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014001.

A model of oil shale compaction during retorting has been developed and incorporated into the one-dimensional retorting model. The model calculates the vertical stress distribution in a column of oil shale rubble and the degree of compaction that these stresses cause. A correlation has been developed that relates shale grade, initial void volume, and vertical stress to the final compaction of the shale bed. The model then determines the gas pressure drop and its effects through the retort. Results of experiments on the decomposition of kerogen in the interim eastern reference oil shale indicate that kerogen and produced bitumen are converted to oil, gas, and residue simultaneously. Hence, the oil production cannot be expressed well in a first-order equation. Comparison of bitumen production from western oil shale, which is highly aliphatic, to that from the more aromatic eastern shale indicates that the formation of bitumen may be a function of oil shale aromaticity. Several samples produced by the recycled hot oil pyrolysis of tar sand were analyzed. Detailed gas chromatography/mass spectrometry analyses were used to evaluate the potential of the pyrolysis product oil as a feedstock for high-density fuel production. The products from the current production conditions were not felt to be suitable. A series of UCG experiments in large coal blocks demonstrated successful gasification of Illinois No. 6 bituminous coal at ash slagging conditions using a borehole link. Gasification condi-

tions for the Rocky Mountain No. 1 field test were tested in a large block of Hanna coal.

45039 **(DOE/FE/60177—2422) Characterization of Rio Blanco retort 1 water following treatment by lime-soda softening and reverse osmosis.** Kocornik, D.J. (Western Research Inst., Laramie, WY (USA)). Dec 1985. Contract FC21-83FE60177. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE88000144.

Laboratory research was initiated to evaluate the chemical, physical, and toxicological characteristics of treated and untreated Rio Blanco oil shale retort water. Wet chemical analyses, metals analyses, MICROTOX assays and particle-size analysis were performed on the wastewater before and after treatment by lime-soda softening and reverse osmosis. The reverse osmosis system successfully removed dissolved solids and organics from the wastewater. Based on MICROTOX tests, the water was much less toxic after treatment by reverse osmosis. 8 refs., 7 figs., 8 tabs.

45040 **(DOE/FE/60177—2423) An evaluation of the potential end uses of a Utah tar sand bitumen.** Thomas, K.P.; Harnsberger, P.M.; Guffey, F.D. (Western Research Inst., Laramie, WY (USA)). Sep 1986. Contract FC21-83FE60177. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE88000142.

To date the commercial application of tar sand deposits in the United States has been limited to their use as paving materials for county roads, parking lots, and driveways because the material, as obtained from the quarries, does not meet federal highway specifications. The bitumen in these deposits has also been the subject of upgrading and refining studies to produce transportation fuels, but the results have not been encouraging from an economic standpoint. The conversion of tar sand bitumen to transportation fuels cannot compete with crude oil refining. The purposes of this study were two-fold. The first was to produce vacuum distillation residues and determine if their properties met ASTM asphalt specifications. The second was to determine if the distillates could serve as potential feedstocks for the production of aviation turbine fuels. The bitumen used for this study was the oil produced during an in situ steamflood project at the Northwest Asphalt Ridge (Utah) tar sand deposit. Two distillation residues were produced, one at +316°C and one at +399°C. However, only the lower boiling residue met ASTM specifications, in this case as an AC-30 asphalt. The original oil sample met specifications as an AC-5 asphalt. These residue samples showed some unique properties in the area of aging; however, these properties need to be investigated further to determine the implications. It was also suggested that the low aging indexes and high flow properties of the asphalts may be beneficial for pavements that require good low-temperature performance. Two distillate samples were produced, one at IBP-316°C and one at IBP-399°C. The chemical and physical properties of these samples were determined, and it was concluded that both samples appear to be potential feedstocks for the production of aviation turbine fuels. However, hydrogenation studies need to be conducted and the properties of the finished fuels determined to verify the prediction. 14 refs., 12 tabs.

45041 **(DOE/FE/60177—2425) Process off-gas characterization experiments for block reactor runs 10 and 12.** Biezugbe. G.B.O.; Place, B.G.; Owen, T.E.; Barbour, A. (Western Research Inst., Laramie, WY (USA)). Jul 1986. Contract FC21-83FE60177. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE88000143.

Western Research Institute (WRI) has developed a facility to study gaseous emissions from a block reactor by sampling volatile trace metals, particulates, and gas condensates. The facility was recently used in two experiments to sample process off-gas from the retorting of an eastern oil shale. Those elements found in measurable quantities in the retort off-gas of the first experiment were silver, aluminium, arsenic, boron, calcium, sodium, iron, mercury, magnesium, molybdenum, phosphorus, selenium, silicon, and zinc. Elements detected in the second experiment were arsenic, boron, calcium, chromium, copper, sodium, iron, mercury, magnesium, nickel, phosphorus, and selenium. The off-gas samples in both experiments contained very low quantities of metals. There are probably several causes for the low recovery of metals. the most salient characteristic of the off-gas from eastern oil shale compared with that from western oil shale is the high concentration of sulfur. The amount of sulfur in the off-gas depends on the sulfur source, reaction, temperature, and steam injection rate. In these experiments, the presence of oxygen in the off-gas allowed the formation of subsequent precipitation of elemental sulfur, thus hampering accurate characterization of the sulfur species in the off-gas. 11 refs., 5 figs., 10 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 44868, 45029, 45035, 45036, 45039, 45040, 45041, 45069

45042 (DOE/FE/60177—2305-Vol.1, pp 3-7) **Isothermal pyrolysis of Colorado oil shale.** Miknis, F.P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objective of this research effort was to explore the chemistry of kerogen thermal decomposition in relationship to kerogen structure. Since the kerogen in oil shales exists in a variety of structural assemblages, understanding the chemistry of kerogen pyrolysis requires investigations of the pyrolysis kinetics of several different types of kerogens. Knowing the chemistry of the pyrolysis of shales having different aromatic and aliphatic carbon distribution is necessary for the development of a general chemical kinetics model of kerogen decomposition. Also, by understanding these relationships it may be possible to improve the efficiency of the conversion processes or to develop novel approaches for greater conversion of kerogen to oil.

45043 (DOE/FE/60177—2305-Vol.1, pp 7-11) **Isothermal decomposition of New Albany shale from Kentucky.** Miknis, F.P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objective of this study was to explore the chemistry of kerogen thermal decomposition in relationship to the kerogen structure of an eastern shale. By understanding this relationship, it may then be possible to improve the efficiency of the conversion processes, or to develop novel approaches for greater conversion of kerogen to oil in eastern shales. This may be particularly important for shales which are high in organic matter but produce little oil by conventional conversion methods.

45044 (DOE/FE/60177—2305-Vol.1, pp 11-14) **Development of an isothermal pyrolysis apparatus.** Turner, T.F. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

One objective of this research was to design and construct a pyrolysis system capable of rapidly heating relatively large oil shale samples to the desired temperatures, thus minimizing nonisothermal effects during pyrolysis. Product recovery is a concern in isothermal pyrolysis experiments because complete material balances are necessary, and because the time dependence of each product must be accurately defined. It is essential to efficiently recover retorted shale, condensible product, and gases. Accordingly, the second and third objectives of this research were to develop an efficient, low-volume liquid product recovery system and to develop a fast-turnaround, accurate gas sampling system.

45045 (DOE/FE/60177—2305-Vol.1, pp 16-18) **Reaction of Green River and Chattanooga oil shales with strong bases and radical-forming reagents.** Branthaver, J.F. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objective of the research was to expose oil shales to a number of reagents known to react with specific compound types that have carbon-heteroatom bonds, e.g., esters, ethers, sulfides, and to determine the effect of such treatments on the properties of the shale organic material. The results of this project are presented.

45046 (DOE/FE/60177—2305-Vol.1, pp 46-49) **Yield loss estimates from product evaluation.** Guffey, F.D. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The Western Research Institute initiated research in the area of oil yield loss estimates from product evaluation to improve the currently available product oil analysis methods for estimating oil yield losses during the retorting of Green River oil shale; obtain a better understanding of the chemistry involved in oil yield loss mechanisms; and determine if diagnostic correlations can be developed for estimating the oil yield losses during the retorting of eastern oil shale. The procedures and results are presented.

45047 (DOE/FE/60177—2305-Vol.1, pp 56-59) **Characterization of interim reference oil shales.** Miknis, F.P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

A continuing objective of the DOE oil shale program is to obtain reference data on the fundamental chemical and physical properties of oil shales of the eastern and western US. An oil shale sample bank has been established by the DOE to provide reference shales to program participants. Oil shale data obtained from the different research programs on the reference shales are thus more consistent and more easily correlated with other oil shale data. Ultimately, the reference shale data will serve as a cohesive data base so chemical and physical properties data for other oil shales can be compared. An important segment of the reference shale project conducted by WRI was to obtain fundamental properties data on the interim reference oil shales and their products.

45048 (DOE/FE/60177—2305-Vol.1, pp 60) **Trace element distribution and oil yield associations of oil shale resources.** Sullivan, P.J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

One of the significant environmental problems associated with oil shale development is the release of inorganic trace elements and organometallics from retorted oil shale. From a solid waste management perspective, it is highly desirable to identify those stratigraphic units in an oil shale resource that contain elevated trace element concentrations before mining and retorting so proper management options can be implemented. Because many trace elements are associated with the organic fraction of sedimentary rocks, Fischer assay oil yield data may be correlated to trace element levels so that oil yields may be used to predict zones of high trace element concentrations. The objectives of this research was to determine if total trace element concentrations of raw oil shale are correlated to Fischer assay oil yield.

45049 (DOE/FE/60177—2305-Vol.1, pp 62-64) **Bibliographic data base on trace elements in oil shale and its products.** Johnson, L.S. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Researchers have been intensively investigating trace elements in oil shale and its products for about the past 15 years. This has resulted in a proliferation of information on the topic. Thus, a need arose to establish a comprehensive bibliographic data base to provide researchers, developers, regulatory agencies, and others with a convenient mechanism for identifying and accessing this literature. The objective of this research effort was to develop a bibliographic data base on trace elements. This was done by collecting all published documents on trace elements in oil shale and its products, abstracting the essential information from these documents, and developing an automatic storage and retrieval system.

45050 (DOE/FE/60177—2305-Vol.1, pp 64-68) **Nitrogen compound types in hydrotreated shale oils.** Holmes, S.A. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objectives of this work were to correlate compound-type distributions with upgrading process conditions and with fuel stability properties. Analytical techniques were to be developed and applied to the analysis of moderate and trace quantities of nitrogen in shale products. The nitrogen-type distributions in several retorted shale oils, hydrotreated whole oils, and acid-clay-treated (finished) fuels were to be determined. It was to be determined if these compositional analyses of retorted and hydrotreated shale oils provided data useful in the understanding of recovery and refining processes.

45051 (DOE/FE/60177—2305-Vol.1, pp 68-72) **Spectrographic analyses of nitrogen fractions from a geokinetics shale oil distillate and a hydroprocessed intermediate.** Netzel, D.A. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Nitrogen compound-type fractions from shale oil are extremely complex mixtures that are difficult to identify and quantify. There is an increasing need to develop new methods to confirm rapidly or complement information obtained from existing methods. The objectives of this project were to obtain high-resolution nuclear magnetic resonance spectra of nitrogen concentrate fractions from a Geokinetics shale oil distillate and the intermediate hydroprocessed distillate oil; to correlate the NMR chemical shift data (compound-type data) with high-resolution mass spectral compound-type analysis, infrared spectrometric and potentiometric titration data; and to increase the understanding of what changes in nitrogen functionality occurred during hydroprocessing.

45052 (DOE/FE/60177—2305-Vol.1, pp 111-114) **Chemical and physical properties of original tar sand bitumens.** Thomas, K.P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objective of the research conducted since May 1983 was to provide chemical and physical property data for the generation of a data base and for base line data so that products recovered by thermal methods could be compared with original materials. In addition, the data were used for development of predictive mathematical models of thermal recovery processes. The chemical properties included both the major and minor elements and chromatographic distribution. The physical properties included among others the gravity, viscosity, and distillation range.

45053 (DOE/FE/60177—2305-Vol.1, pp 114-118) **Chemical and physical properties of oils produced from tar sand.** Thomas, K.P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process

technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objectives of the research conducted since May 1983 were the following: to identify the chemical and physical properties of the thermally produced oils (these were compared with those of the original bitumens to determine the extent of upgrading and to relate to production mechanisms); to use the data for the development of a mathematical model of the thermal recovery process; and to evaluate the properties of the Northwest Asphalt Ridge bitumen so that its potential end use could be evaluated.

45054 (DOE/FE/60177—2305-Vol.1, pp 166-169) **Characterization of clay minerals in a Utah tar sand.** Mason, G.M. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Clay minerals pose problems in the processing of tar sand because of the small particle size and the swelling nature of some species. They can potentially increase the viscosity of aqueous solutions used in the separation of bitumen from tar sand ore materials, thus hindering gravity separation of the aqueous and bitumen phases. In order to more fully determine the effects of clay minerals in the tar sand resource, a program was initiated to characterize the mineralogy of a major US tar sand deposit. One of the largest tar sand deposits occurring in the US is the PR Spring deposit located on the southeastern margin of the Uinta Basin, Utah. The bitumen impregnation at the PR Spring tar sand deposit occurs mainly in the Douglas Creek member of the Green River Formation. The Green River Formation within the Uinta Basin contains thick sequences of rich source-rock sediments of lacustrine and fluviatile origin, noted for oil shale, tar sand, and petroleum deposits.

45055 **(DOE/FE/60177—2417) Clay minerals in a Utah tar sand and their potential effects on processing.** Mason, G.M.; Owen, T.E.; Daley, R.L.; Donovan, R.C. (Western Research Inst., Laramie, WY (USA)). Jun 1986. Contract FC21-83FE60177. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014492.

Because demand for petroleum is ever increasing, all petroleum resources including tar sand should be considered for development. The PR Spring tar sand deposit contains 4.4 billion barrels of oil within an area of 185,000 acres. The bitumen impregnation at the PR Spring tar sand locality occurs mainly in the Douglas Creek Member of the Green River Formation. Clay minerals pose problems in tar sand processing and can potentially increase the viscosity of aqueous solutions used in the separation of bitumen from tar sand materials. In order to more fully determine the effects of clay minerals in the tar sand resource, a program was initiated to characterize the mineralogy (bulk and clay) of a major US tar sand deposit. The specific goals of this research were to identify and quantify the clay minerals (if present) in the tar sand deposit, compare these data to known occurrences and deposits affected by clay minerals, and apply this information towards a more complete understanding of the tar sand resource. Mineralogical determinations of 47 samples from seven core holes were performed to determine the clay mineral quantity and species for the deposit. Five clay mineral species (illite, kaolinite, chlorite, smectite, and mixed-layer structures) were identified, representing both detrital and diagenetic formation. Comparing the clay minerals identified in the PR Spring deposit with those from the Canadian Athabasca deposit revealed similarities and differences. Iron analyses were performed to investigate any correlations with mineralogy, but results showed poor statistical correlation except for a high carbonate to low iron and pyrite relationship. Mineralogical evidence suggests multiple phases of diagenesis as a possible mechanism for porosity enhancement, mineral dissolution, and clay mineral precipitation at the PR Spring tar sand deposit. 24 refs., 15 figs., 5 tabs.

45056 **(DOE/FE/60177—2419) Selected elemental distributions as determined by reference retorting of oil shale and possible correlation with Fischer assay oil yield.** Johnson, L.S.; Wood, F.J. Jr. (Western Research Inst., Laramie, WY (USA)). Aug 1986. Contract FC21-83FE60177. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87014900.

In previous work, the concentrations and distribution of selected elements in oil shale retort products were reported for the Department of Energy interim reference shales and Mahogany zone shale from Colorado corehole No. 1. As an extension of this work, the distribution of the same elements for a new shale group was investigated. The new shale group was composed of rich and lean shale pairs from other Mahogany zone coreholes in the Piceance Creek and Uinta Basins. This report summarizes graphically the distribution data collected to date, including data for the reference shales, Colorado corehole No. 1, and the rich and lean shale pairs. Also included are elemental concentrations by product stream for the new shale group. The data previously reported for Colorado corehole No. 1 were combined with the data from the new shale group to develop a capability for predicting the distribution of these elements in the different product streams. The data collected for the reference shales were not considered in the development of this predictive capability. The empirical data were collected for the new shale group using the same experimental approach as previously reported. Briefly, the general experimental design was to use mass balance Fischer assay as a reference retorting method, with subsequent analysis of the feedstock and all retort products for the elements of concern by instrumental analysis. The elements examined were arsenic, barium, cadmium, chromium, copper, lead, mercury, nitrogen, selenium, silver, sulfur, and zinc. Initially, data analysis also remained the same. Unlike the previous work, statistical analysis was used to test for differences between shale groups for the distribution of a given element in a given product stream. 42 refs., 61 figs., 27 tabs.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 45040, 45067

45057 **(AD-A—181865/7/XAB) Capillary GC (gas chromatography) detection methods for nitrogen and sulfur compounds in shale-derived jet-propulsion fuels. Final report, March 1985-March 1986.** Steward, E.M.; Pitzer, E.W. (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA)). Dec 1986. 43p. (AFWAL-TR—86-2043). NTIS, PC A03/MF A01.

Correlations have been drawn between nitrogen and sulfur content in jet-propulsion fuel and poor fuel performance. Recent studies have suggested that certain nitrogen and sulfur compound classes are more detrimental to fuel performance than others. This report emphasizes the importance of knowing which nitrogen and sulfur compound classes are present in jet propulsion fuel and demonstrates the ability of several capillary gas chromatographic (GC) detectors to selectively detect individual nitrogen and sulfur compounds in these fuels.

45058 (DOE/FE/60177—2305-Vol.1, pp 257-259) **Modification of petroleum asphalts with shale oil residues.** Petersen, J.C. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The high nitrogen content of shale oil is undesirable if the shale is to be used as a fuel. Combustion of nitrogen compounds produces atmospheric contaminants, and their removal from shale oil during upgrading and refining is difficult and expensive. During distillation, nitrogen compounds are concentrated in the high boiling residues. These residues are the shale oil fractions least desirable for fuel use. Previous research in the pavement asphalt area has shown that asphalt-aggregate mixtures produced in the laboratory from shale oil-derived asphalt are significantly more resistant to moisture damage than corresponding mixtures prepared from petroleum asphalts. In spite of its potential to improve moisture resistance in paving mixtures, shale oil asphalt is reactive with atmospheric oxygen which leads to rapid age hardening. Age hardening of pavement binders usually leads to premature pavement cracking and reduced pavement life. The objective of this exploratory study was to determine if petroleum asphalts could be modified with shale oil residues to permit utilization of the residues in pavements

with minimum adverse effects from age hardening while still maintaining the benefits of reduced moisture damage. It was postulated that the petroleum asphalt might moderate the oxidation of shale oil components.

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 45039, 45071, 45072

45059 (DOE/FE/60177—2305-Vol.1, pp 72-76) **Off-gas characterization and cleanup for simulated in situ retorting experiments.** Nordin, J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The primary objective of this research effort was to characterize off-gases from retorting experiments conducted in WRI's 10-ton retort and block reactor. In addition, venturi scrubbing was evaluated as a control technology for removal of hydrogen sulfide and oil aerosols. The objective of the study of the venturi scrubber was to evaluate a control technology for removing hydrogen sulfide and particulates without removing carbon dioxide.

45060 (DOE/FE/60177—2305-Vol.1, pp 77-81) **Separation and detection of sulfur, nitrogen, and arsenic species in oil shale by-product waters using ion chromatography.** Poulson, R.E. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Oil shale retort waters and scrubber waters contain ionic sulfur and nitrogen species as principal components. Among minor and trace elements present, arsenic (As) is of special environmental concern. Determination of chemical species is important because the species of the elements define their potential transport, eventual fate, and effect on the environment. The present research was undertaken to fulfill the need for near real-time analyses for ionic species at low and trace levels in freshly prepared process products and by-products. The primary focus was on IC for sulfur-containing anions, ammonia and low-molecular-weight alkylamines (with or without the presence of alkanolamines), and arsenic-containing anions. The sulfur species analyses were to be amenable to retort-site operation because of the numerous unstable species known to be present in fresh products. The arsenic work consisted of feasibility studies in novel methods of on-line detection as possible improvement over off-line vapor phase emission or atomic absorption spectrometric methods. Incidental to the ion chromatography work would be the development of methods for stable species, i.e. general anion and general cation analyses for products and ground waters, for comparison with standard and vapor-phase spectrometric methods.

45061 (DOE/FE/60177—2305-Vol.1, pp 81-85) **Profiling of organic solutes in oil shale by-product waters.** Poulson, R.E. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objective of this research was to develop a framework for characterization of oil shale processing aqueous effluents. This framework would be of use in modeling the various physicochemical processes entering into the transport equations. Indicator species would be determined for the many physicochemical processes expected so that very sensitive methods of detection could be applied in environmental field situations. Key indicator species would be selected to simplify laboratory bench study of key processes determining the fate of environmentally offensive solutes. RPLC profiling would be an important part of physicochemical process characterization. Hydrophilic fractions would be of special interest because of their inherent mobility and because little previous work exists for these species.

45062 (DOE/FE/60177—2305-Vol.1, pp 91-94) **Characteristics of leachates from retorted oil shales.** Sorini, S. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The retorting of oil shale on a commercial basis is expected to generate 1.2 million tons of spent shale daily. Disposal of spent shale has raised concern over the potential contamination of ground and surface waters by inorganic and organic species leached from this waste. The purpose of this research was to evaluate leachate quality through laboratory leaching studies of oil shale and codisposed wastes. The specific objectives of the research were to evaluate the chemical differences of leachates from identical spent shales produced by various laboratory leaching procedures; determine the variations in the chemical composition of leachates from spent shales generated by four retorting procedures; determine the chemical composition of leachates generated from spent shales compacted with retort water and aged; determine the leachate composition from retorted shales contacted with various types of treated shale retort waters; and compare the elemental concentrations of laboratory-generated leachates with the levels considered hazardous in the Environmental Protection Agency (EPA) hazardous waste guidelines.

45063 (DOE/FE/60177—2305-Vol.1, pp 94-97) **Leaching of retorted oil shale with complexometric agents.** Essington, M.E. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The mineralogical residencies of trace elements in retorted oil shale have not been well characterized. Furthermore, retorted oil shale solids have not been characterized to the extent necessary to identify trace element-adsorbing solids. Characterizations of retorted oil shale leachates have resulted, however, in the identification of a great many trace element-complexing ligands. Moreover, retort waters, whose codisposal with retorted oil shale has been proposed, have also been found to contain a great many trace element-complexing ligands. The formation of aqueous trace element complexes results in both the increased solubilization and mobility of trace elements in an environment, irrespective of trace element mineralogical residencies and adsorbing surfaces. This property of complex chemical systems suggests a methodology is needed to assess the maximum leachability of trace elements from retorted oil shale wastes before disposal. The objective of this study was to assess the ability of complexometric agents to extract trace elements from retorted oil shale. The complexometric agents are indigenous to retorted oil shale leachates and are present in waste retort waters. The agents are used in hazardous waste assessment procedures.

45064 (DOE/FE/60177—2305-Vol.1, pp 98) **Oxidation-reduction and leachate chemistry of restored oil shale.** Sullivan, P.J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The long-term quality of water produced at spent oil shale disposal facilities is a critical concern. Understanding the release and mobility of trace elements as natural weathering of the disposal pile occurs is particularly important. Because oil shale solid waste leachates are generally alkaline, weathering reactions that increase leachate acidity, thus trace element release and mobility, need to be understood. The wastes should be leached under saturated and unsaturated environments to simulate weathering environments that would occur in a waste disposal pile. The purpose of this research was to determine the influence of geochemical weathering on retorted oil shale and trace element release as a function of an oxidizing environment where sulfide weathering and carbon dioxide ab-

sorption influences the pH of the leachate and a reducing environment where oxygen and carbon dioxide contact is limited.

45065 (DOE/FE/60177—2305-Vol.1, pp 99-102) **Influence of retorted oil shale recarbonation on mineralogy and element mobility.** Essington, M.E. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The objectives of this study were to (1) characterize the mineralogy of retorted oil shale and recarbonated retorted oil shale using indirect and direct methods of analysis, (2) characterize the chemical nature of retorted oil shale equilibrating solutions as a function of time, temperature, solid-to-solution ratio, and carbon dioxide partial pressure, (3) assess the influence of recarbonation on trace element leachability, and (4) utilize a sequential selective dissolution technique to characterize the mineralogical residencies of trace elements in retorted oil shale and recarbonated retorted oil shale.

45066 (DOE/FE/60177—2305-Vol.1, pp 103-108) **Methods for geochemical model evaluation.** Essington, M.E. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The environmental behavior, fate, and potential impact of an element is influenced to a great extent by its chemical speciation. Methods for characterizing analytically the chemical speciation of an element in an aqueous solution are available. However, in situ characterization of elemental speciation is not possible, as any perturbation of a chemical system (brought about even by sampling) will result in a corresponding change in elemental distribution. The objectives of this study were to review the general approaches to determining aqueous phase chemical speciation analytically and to outlining a feasible approach to speciating chromium (3) and chromium (6) analytically in a dilute aqueous solution.

45067 (DOE/FE/60177—2305-Vol.1, pp 162-166) **Water characterization and treatment.** Hill, S.L.; Barker, F.P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

One of the goals of the US Department of Energy tar sand program is to mitigate the potential environmental impacts of tar sand extraction processes. This has required detailed characterization of the by-products of extraction processes, assessment of the potential environmental impacts associated with the by-products, and development of treatment technologies to manage the by-products. These experiments were designed to test high-pressure steam displacement and reverse combustion as processes for recovering oil from tar sand. The commercial extraction operations were conducted by private industries at sites in Texas and California. One of the commercial operations utilized a steam-drive process whereas the other utilized cyclic steam injection and steam drive. The primary objectives of this research were to characterize the by-products of tar sand extraction processes and to develop technologies appropriate for the treatment of those by-products. To achieve these objectives, Western Research Institute focused its research efforts on the following: physicochemical and toxicological characterization of waters generated during experimental extraction processes; physicochemical and toxicological characterization of waters generated during commercial extraction processes; evaluation of treatment operations suitable for various types of process waters using discharge and reuse as treatment objectives; and evaluation of tar sand environmental research and identification of future research requirements.

45068 (DOE/FE/60177—2305-Vol.1, pp 169-174) **Wastewater treatment during bitumen recovery from tar sand.** Nordin, J.S. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Tar sand deposits in the US are estimated to contain over 50 billion barrels of oil. Recovery of this resource requires large quantities of water, which is in short supply in the arid western states. Therefore, waste waters should be treated for reuse within the production facility when possible or adequately treated before being discharged to the environment. The objective of this research was to systematically analyze the economic and environmental benefits and detriments associated with process water disposal and reuse in the tar sand industry. This work supported the process engineering effort for emissions and effluent characterization.

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 44864, 45027, 45048, 45061, 45063, 45066

45069 (DOE/FE/60177—2305-Vol.1, pp 61) **Distribution of selected elements in oil shale retort products.** Johnson, L.S. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The development of a commercially viable oil shale industry will require a technology capable of producing a high-quality oil product while meeting environmental regulations. The release of trace elements, nitrogen compounds, and sulfur compounds to the environment at above allowable levels is one area of concern. Another area of concern is the removal of heteroatom species from the shale oil product. Information that will help develop the capability for predicting the distribution of trace elements, nitrogen, and sulfur in the final retort products is necessary for developing appropriate environmental mitigation strategies and for process design. The objectives of this research were to identify the distribution of selected elements in oil shale retort products from shale from a number of core holes located in the Piceance Creek and Uinta basins, to characterize the Department of Energy's interim reference shales in terms of this distribution, and to develop a capability for predicting the observed patterns of distribution for the selected elements.

45070 (DOE/FE/60177—2305-Vol.1, pp 85-87) **Characterization of waters from retort 1 at least tract C-a.** Renk, R.R.; Poulson, R.E. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The Rio Blanco Oil Shale Company developed and operated a modified in situ oil shale recovery process on Federal Prototype Oil Shale Tract C-a in Colorado's Piceance Creek Basin near Rifle, Colorado. Starting in June of 1981, retort 1, a 60-foot square by 400-foot high column of oil shale rubble, was retorted for five months. After the retort was complete flooding of the cavity occurred in June 1984. Ground water was left in contact with the retort for one year to leach organic and inorganic materials from the cavity. In late May 1985, 17.4 million gallons of water was pumped from retort 1 to flush contaminated water from the retort. This pumping process was repeated again in June 1986. The objectives of this study were to characterize waters from retort 1 and the vicinity (1) to determine possible effects on the ground water and aquifers in the area, (2) to examine the fate of possible contaminants in the retort, and (3) to evaluate possible procedures for mitigating potential damage to ground water and aquifers.

45071 (DOE/FE/60177—2305-Vol.1, pp 87-91) **Retort water characterization and evaluation of treatment methods.** Nordin, J. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

Waters produced during retorting of oil shale contain inorganic salts and high concentrations of organic materials in both emulsified and dissolved states. Many of the organic constituents are volatile, while others are stable colloids. The characterization of oil shale waters and the development of treatment technologies for contaminant removal are important to the development of an environmentally acceptable oil shale industry. The objectives of this study were to characterize waters produced in retorting experiments and to evaluate possible methods for treating the waters. The major characterization effort was directed towards identifying and evaluating chromatographic profiles of organic materials contained in these waters, either in the retort water itself or after bench-scale laboratory treatment tests simulating various water treatment processes.

45072 (DOE/FE/60177—2305-Vol.1, pp 123-126) **Criteria for the selection and monitoring of in situ, thermal recovery processes.** Thomas, K.P. Dec 1986. NTIS, PC A12/MF A01. File Number DE87008444.

In Western Research Institute: research investigations in oil shale, tar sand, underground coal gasification, advanced process technology, asphalt research, April 1983-September 1986: Volume 1, Final report.

The US has about 54 billion barrels of bitumen in tar sand deposits. However, only about 10 to 15% of this bitumen can be recovered by conventional, surface mining techniques. This implies that the remainder will have to be recovered by in situ, thermal recovery processes. However, the efficient and economic recovery of this very viscous material (greater than 10,000 cp at reservoir temperature) in an environmentally acceptable manner will be a difficult task. To accomplish this task, the deposit characteristics need to be matched with process requirements and environmental considerations. The objectives of this study were threefold. First, the technical and nontechnical factors which must be considered prior to development of a tar sand deposit would be defined. Second, the chemical and physical parameters necessary for the monitoring of an in situ process would be determined. Third, a preliminary screening of thermal recovery processes would be conducted on tar sand ore from a deposit.

45073 **Environmental risk assessment for a future oil shale industry in the western U.S.** Gratt, L.B. (IWG Corp., San Diego, CA). pp 428-435 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

A future Oil Shale industry will be a massive solids-handling industry generating large amounts of hazardous materials in all environmental media. An analysis was performed to assess the environmental risks of such an industry. The analysis considered ecosystem, occupational, and public risks for a hypothetical steady-state industry producing one million barrels-per-day. Ecosystem risks considered impact on designator species, plant damage from sulfates, and disturbance in plant communities. Potential changes associated with surface water quality changes from the production of leachates were indicated. Occupational health and safety conditions were analyzed for the Oil Shale fuel cycle from extraction to delivery of products for end use. The shale miners represented the group with the largest fatality and the most serious accident rate. Lung disease from inhalation exposure to dust about the nuisance dust threshold limit value presented the most significant risk for future concerns.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 45557

0501 Reserves, Exploration, And Mining

45074 **(CREGU—2) Uranium deposits associated to tertiary acid volcanism of the Pena Blanca Sierra (Chihuahua, Mexico).** Aniel, B. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)). Dec 1986. 292p. (In French). NTIS (US Sales Only), PC A13/MF A01. File Number DE87752246.

The uraniferous deposits located in the Sierra de Pena Blanca (Chihuahua, Mexico) are the consequence of successive events that modified acid volcanic rocks. The devitrification of the Nopal Formation, vitroclastic tuffs, is essential in the cooling history because it releases uranium that becomes available. The uranium present in fluids as uranylcarbonate complexes, precipitate along the lamellea of hematite (exsolutions of the ilmenites). The presence of sulfur causes the destabilization of the ilmenites with uranium oxide (pitchblende - titanium oxide - pyrite), the pseudomorph of magnetites (pitchblende - pyrite) and the transformation of hematite into pyrite. The silice coming from the kaolinization of feldspars recristallizes as microcristalline quartz so that the rock appears compact. Fractures cause the uplifting of the lower unit of Nopal formation. It has been altered to montmorillonite. A carbonylation of this tuff has been observed and these two types of alteration occur after kaolinization. The Escuadra formation overlies the Nopal formation. The deposition takes place on an eroded basement where a soil developed. The two formations will together undergo transformations due to the saturation level and the primary ore will be only oxidized or oxidized, transported and reconcentrated. Late and localized thermal activities have been observed and may be the result to tectonic movements occurring after the supergene modification.

45075 **(CREGU—5) Peraluminous leucogranitic complex of St. Sylvestre (France, Massif Central NW). Evolution of the crystallochemistry of mineral phases and of the geochemistry of major and trace elements. Polygenetism characterization in peraluminous granites. Implication on uranium metallogeny.** Friedrich, M. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)). Jul 1983. 362p. (In French). NTIS (US Sales Only), PC A16/MF A01. File Number DE87752280.

The main purpose of this study is to improve the knowledge of the behaviour of uranium during magmatic and late magmatic processes. In France and other part of the world the close association of uranium (Sn-W) deposits and showings with this type of granite justifies the metallogenic interest of this study. At the scale of the whole granitic complex two distinct petrological groups are redefined: the facies of Brame and St. Sylvestre. Mineral paragenesis closely follow the geochemical differentiation. Abundance of uraninite and scarcity of monazite and zircon, are additional features of these samples. The opposite behaviour of monazite (typical of the less evolved facies) and uraninite (whose abundance is directly related to the degree of differentiation) suggests two conclusions. Abundance in uranium is directly related to the magmatic differentiation processes. The early crystallization of monazite and zircon and their high abundance in poorly evolved facies imply a compatible behaviour for Th, Zr and light rare earths. More detailed geochemical studies evidence heterogeneities at on hectometric and locally at a metric scale. Differentiation processes, which appear to be continuous at a kilometric scale in the St. Sylvestre facies, are discontinuous at the hectometric and metric scale. Such petrogeochemical discontinuities, implying petrogenitic heterogeneities are expressed in the concept of polygenetism.

45076 **(PNL—6207) Assessment of the integrity of spent fuel assemblies used in dry storage demonstrations at the Nevada Test Site.** Johnson, A.B. Jr.; Dobbins, J.C.; Zaloudek, F.R. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 186p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87014699.

This report summarizes the histories of 17 Zircaloy-clad spent fuel assemblies used in dry storage tests and demonstrations at the Engine Maintenance and Disassembly (EMAD) and Climax facilities at the Nevada Test Site (NTS). The 18th assembly was shipped to the Battelle Columbus Laboratory (BCL) and remained there for extensive characterization and as a source of specimens for whole-rod and rod-segment dry storage tests. The report traces the history of the assemblies after discharge from the Turkey Point Unit 3 pressurized-water reactor (1975 and 1977) through shipment (first arrival at EMAD in December 1978), dry storage tests and demonstrations, and shipment by truck cask from EMAD to the Idaho National Engineering Laboratory (INEL) in May/June 1986. The principal objectives of this report are to assess and document the integrity of the fuel during the extensive dry storage activities at NTS and BCL, and to briefly summarize the dry storage technologies and procedures demonstrated in this program. The dry storage tests and demonstrations involved the following concepts and facilities: (1) surface drywells (EMAD); (2) deep drywells (425 m underground in the Climax granite formation); (3) concrete silo (EMAD); (4) air-cooled vault (EMAD); (5) electrically-heated module for fuel assembly thermal calibration and testing (EMAD/FAITM). 20 refs., 43 figs., 9 tabs.

0504 Feed Processing

45077 **(WINCO—1037) Pilot plant operation of a geometrically safe denitrator at the Idaho Chemical Processing Plant.** Croson, D.V.; Rindfleisch, J.A.; Petig, A.V. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Jun 1987. Contract AC07-84ID12435. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014619.

This report describes the results of a testing program designed to improve the fluidized bed denitration process at the Idaho Chemical Processing Plant (ICPP). Several equipment modifications were made to the existing process to obtain a critically safe system by geometry and to increase throughput from 4.5 to 7 L/h. Procedural changes were made and optimum operating parameters were found, resulting in improved overall performance of the system.

0505 Uranium Enrichment

45078 **(K/ITP—147) Gas centrifuge power supplies (inverters): Key components and subassemblies.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Aug 1987. Contract AC05-84OT21400. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014603.

This document was prepared to serve as a guide for export control officials in their interpretation, understanding, and implementation of exports laws that relate to the international trigger list entry for gas centrifuge power supplies (also known as frequency changers, convertors, or inverters) and parts, components, and subassemblies of such power supplies. Particular emphasis is placed on descriptions of the key parts, components, and subassemblies of such power supplies, which were previously unspecified, so as to clarify the intent of the international trigger list entry.

45079 **(K/TR—87/1) Consideration of a laser enrichment module: Module characteristics from the viewpoint of energy consumption.** Arisawa, Takashi; Shiba, Yoshiyuki. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Japan Atomic Research Inst., Tokai, Ibaraki. Dept. of Fuels and Materials Research). 1987. Contract AC05-84OT21400. Translation of JAERI-M 83-135, September 1983. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014148.

Several problems are discussed for designing a simplified enrichment module based on Atomic Laser Isotope Separation Method, which involve the vaporization of metal, laser excitation, laser ionization and ion recovery. The conditions at which the consumed energy has the minimum value are obtained by calculating the specific energy consumption for producing unit amount of enriched products. It is found that there should be an appropriate relationship between the processing atomic density and the electrode gap in order to avoid the enrichment loss caused by the charge exchange during the ion recovery. Moreover, it is also found that this relation depends on the electrode length measured along both the atomic beam direction and the laser beam direction.

0507 Fuels Production And Properties

45080 **Beginnings of analytical chemistry and bioassay at the University of Chicago Metallurgical Project.** Schubert, J. (Michigan State Univ., Dept. of Biochemistry, East Lansing, MI 48824). pp 2.1 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

In 1943, an experimental reactor was built west of Chicago (Argonne National Laboratory), and a pilot-plant reactor was built at the Clinton Laboratories in Oak Ridge. These activities led to a restructuring of the Met Lab which now consisted of the three major labs at Chicago, Argonne, and Clinton, associated labs at Ames, Berkeley, M.I.T., and some seventy other cooperating groups with A.H. Compton as Project Director. The responsibility for the development from lab to pilot plant to large scale operations was assigned to E.I. DuPont de Nemours and Company at the Clinton Labs and the Hanford Plutonium Plant. The Met Lab, as such, ended on June 30, 1945. The Chicago operation eventually became the Argonne National Laboratory located west of Chicago. At first, the aim was to develop analyses for impurities in uranium. This was extended to include the testing and development of methods for the purification of uranyl nitrate hydrate (UNH) in order to reduce levels of neutron absorbing impurities in UNH prior to the preparation of uranium metal and uranium oxide needed for Fermi to build a self-sustaining nuclear reactor. The author reports in this paper mainly the technical aspects of the chemical work.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 45161, 45332

45081 **(DP—1725) Reclamation of plutonium from pyrochemical processing residues.** Gray, L.W.; Gray, J.H.; Holcomb, H.P.; Chostner, D.F. (Savannah River Lab., Aiken, SC (USA)). Apr 1987. Contract AC09-76SR00001. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014262.

Savannah River Laboratory (SRL), Savannah River Plant (SRP), and Rocky Flats Plant (RFP) have jointly developed a process to recover plutonium from molten salt extraction residues. These NaCl, KCL, and $MgCl_2$ residues, which are generated in the pyrochemical extraction of ^{241}Am from aged plutonium metal, contain up to 25 wt % dissolved plutonium and up to 2 wt % americium. The overall objective was to develop a process to convert these residues to a pure plutonium metal product and discardable waste. To meet this objective a combination of pyrochemical and aqueous unit operations was used. The first step was to scrub the salt residue with a molten metal (aluminum and magnesium) to form a heterogeneous "scrub alloy" containing nominally 25 wt % plutonium. This unit operation, performed at RFP, effectively separated the actinides from the bulk of the chloride salts. After packaging in aluminum cans, the "scrub alloy" was then dissolved in a nitric acid - hydrofluoric acid - mercuric nitrate solution at SRP. Residual chloride was separated from the dissolver solution by precipitation with $Hg_2(NO_3)_2$ followed by centrifuging. Plutonium was then separated from the aluminum, americium and magnesium using the Purex solvent extraction system. The ^{241}Am was diverted to the waste tank farm, but could be recovered if desired.

45082 **(INIS-mf—10702) Transport characteristics of thorium nitrate in different practice-oriented solutions and diffusion coefficients of plutonium(IV)-nitrate in a nitric acid solution. A contribution to the optimization of the reprocessing of nuclear fuels.** Binder, C. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Chemie). 7 Nov 1984. 154p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-10705.

The knowledge of the transport behavior of the salts of actinides and problem elements in aqueous and non-aqueous systems describes important fundamentals for the theoretical comprehension of the technique and its optimization. This thesis offers a contribution to the completion of the transport data with regard to the uncertainties in thorium nitrate systems encountered in practice. This is of importance in the framework of the Thorex process as well as the Purex process, because thorium compounds can be seen and used as quasi inactive model substances for plutonium(IV) compounds.

45083 **(LA-UR—87-643) Applications of molten salts in plutonium processing.** Bowersox, D.F.; Christensen, D.C.; Williams, J.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 19p. (CONF-871027—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87006062.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Plutonium is efficiently recovered from scrap at Los Alamos by a series of chemical reactions and separations conducted at temperatures ranging from 700 to 900°C. These processes usually employ a molten salt or salt eutectic as a heat sink and/or reaction medium. Salts for these operations were selected early in the development cycle. The selection criteria are being reevaluated. In this article we describe the processes now in use at Los Alamos and our studies of alternate salts and eutectics.

45084 **An integrated nondestructive assay system for a new plutonium scrap recovery facility.** Baker, M.P.; Hsue, S.T. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 75-78(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

A consortium of laboratories is collaborating with the Savannah River Plant to develop an integrated system of state-of-the-art nondestructive assay (NDA) instrumentation to provide nuclear materials accounting and process control information for a new plutonium scrap recovery facility. Individual microcomputer-based instruments report assay results to an Instrument Control Computer (ICC). The ICC, in turn, is part of a larger computer network that includes computers that perform process control and nuclear material accounting functions. Integrated system design considerations, integral testing, and individual instrument measurement functions are discussed.

45085 **Remote vacuum cleaner for PUREX cells.** Shepard, D.G.; Deichelbohrer, P.R. (Rockwell Hanford Operations, Richland, WA). *Transactions of the American Nuclear Society;* **53**: 512(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

In PUREX, remote handling of hazardous solid material is done with canyon cranes. Mechanical handling of nuclear material is kept to a minimum by dissolving the feed fuel stock as early as practical in the PUREX process, allowing subsequent steps to be performed by pumping. Removal of fine material, such as gravel, rust, dried chemicals, etc., from cells is particularly troublesome. The need to remove fine material has become more important since the restart of PUREX. Aerosol and spilled acids have degraded some of the concrete in the cell floors over the years and have eaten material from vessel support dunnage, generating quantities of rust powder. These materials need to be removed and disposed of to allow repair of surfaces in the cells and to reduce migration of contamination out of the cells into the canyon. To remove fine material and spilled liquid, Rockwell Hanford Operations developed a vacuum cleaner that can be handled by a crane hook. The vacuum cleaner system is described. Tests of the vacuum cleaner system have demonstrated satisfactory operation.

45086 **(Y/TR—87/4) Process for dissolving slightly soluble thorium and/or plutonium oxides.** Ledebrink, F.W.; Rosenkranz, W.; Stoll, W. (Oak Ridge Y-12 Plant, TN (USA); Alpha Chemie und Metallurgie G.m.b.H. (ALKEM), Hanau (Germany, F.R.)). [1987]. Contract AC05-84OS21400. Translation of European Patent Application 0 049 827, October 1, 1981. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014490.

The oxides are heated in concentrated nitric acid in the range of 120 (200) to 300°C in a sealed vessel containing an O_2 and/or ozone atmosphere at a pressure above atmospheric pressure. The vessel material or coating is Ta, Au, Pt, and/or polytetrafluoroethylene. (DLC)

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REFER ALSO TO CITATION(S) 45149, 45990, 45993

45087 **(CONF-871045—8) OECD [Organization for Economic Co-operation and Development] criticality calculations Working Group report: The need for critical experiments data.** Whitesides, G.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013182.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

Representatives from eleven member countries of the Organization for Economic Co-operation and Development (OECD) participated in an exercise to validate computer calculations designed to evaluate the criticality safety for several fissile material transport and handling situations. A procedure evolved from this work which has been shown to demonstrate whether a given computation method produces "valid" results. This procedure is expected to provide a basis for acceptance of computational results on an international basis by regulatory authorities through the comparison of methods used by the various countries. Even though not an initial topic for the Working Group, the study demonstrates the need for additional critical experiments. This paper examines each study and identifies experiments that could (1) provide useful extensions to the validation and (in the case of the current study) (2) identify a need which is essential for a rigorous validation of systems in which fissile material in solid form is surrounded by fissile material in solution.

45088 **(DOE/IG—0244) Transportation planning for Civilian Radioactive Waste.** (USDOE Office of Inspector General, Washington, DC. Capital Regional Office). 19 Aug 1987. 17p. H. File Number TI87014299.

The subject report concerns the Office of Civilian Radioactive Waste Management's (Waste Management Office) plans to develop a series of 10 new shipping casks to transport radioactive waste from nuclear generating plants to repositories. The estimated cost of $146 million for development of new shipping casks was justified in planning documents as the most cost effective method to meet future shipping requirements. However, our review shows that the development of the full complement of casks at this time is premature and should be reevaluated in light of recent changes affecting the program. In particular, the development of two overweight truck casks and a rail/barge cask, at an estimated cost of $45.3 million, calls for delay and further justification. We recommended that the Waste Management Office establish levels of minimum criteria for each cask to meet in order to qualify for further funding; review the types of casks scheduled for development to justify their development, considering recent changes in the program; and discontinue development on the overweight truck casks and the rail/barge cask until they prove acceptable to federal and state authorities and are shown to meet Nuclear Regulatory Commission requirements. Management concurred with our recommendations but not with the finding.

45089 **(LA-UR—87-2532) Fissile material storage vaults: Designing to enhance safety and efficiency.** McLaughlin, T.P. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-871045—9). NTIS MF A01; 2; GPO Dep. File Number DE87013168.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

There are several, sometimes conflicting, interests which must be accommodated in fissile material, storage vaults. These include criticality safety, radiation safety, fire protection, accountability, and safeguards in addition to the operational requirements of efficiency and, for automated vaults, reliability. A combination of these factors coupled with increasing demands on available vault space and the desire to minimize on-site transportation of special nuclear materials has resulted in current design and construction activities for three major fissile material storage vaults and the renovation of an existing vault at the Los Alamos National Laboratory. Two of these new vaults will be provided with automated stacker-retriever systems similar to those common in large warehouse operations while the third vault, being smaller and having less potential for radiation exposures will be operated in a hands-on mode.

45090 **(ORO—651-Rev.5) Uranium hexafluoride: Handling procedures and container descriptions.** (USDOE Oak Ridge Operations Office, TN). Sep 1987. Contract AC05-84OR21400. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014088.

The US Department of Energy (DOE) guidelines for packaging, measuring, and transferring uranium hexafluoride (UF_6) have been undergoing continual review and revision for several years to keep them in phase with developing agreements for the supply of enriched uranium. Initially, K-1323 "A Brief Guide to UF_6 Handling," was issued in 1957. This was superceded by ORO-651, first issued in 1966, and reissued in 1967 to make editorial changes and to provide minor revisions in procedural information. In 1968 and 1972, Revisions 2 and 3, respectively, were issued as part of the continuing effort to present updated information. Revision 4 issued in 1977 included revisions to UF_6 cylinders, valves, and methods to use. Revision 5 adds information dealing with pigtails, overfilled cylinders, definitions and handling precautions, and cylinder heel reduction procedures. Weighing standards previously presented in ORO-671, Vol. 1 (Procedures for Handling and Analysis of UF_6) have also been included. This revision, therefore, supercedes ORO-671-1 as well as all prior issues of this report. These guidelines will normally apply in all transactions involving receipt or shipment of UF_6 by DOE, unless stipulated otherwise by contracts or agreements with DOE or by notices published in the Federal Register. Any questions or requests for additional information on the subject matter covered herein should be directed to the United States Department of Energy, P.O. Box E, Oak Ridge, Tennessee 37831, Attention: Director, Uranium Enrichment Operations Division. 33 figs., 12 tabs.

45091 **(PNL-SA—14822-S) Long-term storage of spent fuel.** Gilbert, E.R. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 5p. (CONF-8704195—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012174.

From 1. Carver Research Foundation conference on issues pertinent to radioactive waste processing, management and disposal; Tuskegee, AL, USA (3 Apr 1987).

The Nuclear Waste Policy Act of 1983 authorized cooperative agreements between the Department of Energy (DOE) and the utilities to perform tests and demonstrations required to license dry storage of spent fuels. This presentation describes tests and demonstrations of dry storage and rod consolidation by the utilities and DOE. The utilities are now able to temporarily accommodate their increasing inventory of spent fuels. However, this is a temporary solution, for the Nuclear Regulatory Commission licensed this technology for only 20 years, anticipating that the fuel would later be disposed through the interim integrated monitored retrievable storage and repository disposal programs. (AT)

45092 **(PNL-SA—15094) Spent fuel storage technical exchange.** (Pacific Northwest Lab., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1987. Contract AC06-76RL01830. 320p. (CONF-8705162—Vugraphs). NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87012683.

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

The Spent Fuel Storage Technical Exchange Meeting was sponsored by US DOE, PNL and EPRI and was held at Germantown, MD, May 12 to 13, 1987. This report consists mostly of viewgraphs presented at the meeting. Papers have been entered individually into EDB and ERA. (LTN)

45093 (PNL-SA—15094, pp 10-56) **Spent Fuel Dry Cask Storage program at the Idaho National Engineering Laboratory.** Jensen, M.F.; Schoonen, D.H. (EG & G Idaho, Inc., Idaho Falls). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45094 (PNL-SA—15094, pp 57-87) **Virginia Power/DOE/EPRI PWR spent fuel storage cask performance testing and analysis.** Creer, J.M.; McKinnon, M.A.; Tanner, J.E.; Wheeler, C.L.; McCann, R.A.; Michener, T.E. 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45095 (PNL-SA—15094, pp 88-97) **Surry Power Station dry cask ISFSI.** McKay, H.S. (Virginia Power Co., Glen Allen). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45096 (PNL-SA—15094, pp 98-117) **Development of the H.B. Robinson plant independent spent fuel storage installation.** McLean, J.C. (Carolina Power & Light Co., Raleigh, NC). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

Casks containing the spent fuels are stored in concrete shielding modules, through which air is circulated for temperature control.

45097 (PNL-SA—15094, pp 118-128) **Status of NUHOMS technology.** Massey, J.V. 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

Spent fuel casks are stored in individual concrete modules.

45098 (PNL-SA—15094, pp 129-165) **NU/EPRI/DOE/BG & E/CE Fuel Consolidation Demonstration program, Millstone Unit No. 2.** Kupinski, M.; Betancourt, G.N. (Northeast Utilities, Hartford, CT). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45099 (PNL-SA—15094, pp 166-175) **Rod consolidation equipment technology.** Moscardini, R.L. (Combustion Engineering, Inc., Windsor, CT). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45100 (PNL-SA—15094, pp 176-189) **Results of rod consolidation demonstration at Battelle Columbus.** Wachter, W.J. (US Tool & Die, Inc., Allison Park, PA). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

The US Tool & Die Consolidation System has successfully consolidated some of the worst spent fuel in the industry. This program has provided proof that the system can handle off-normal conditions worse than any that will be encountered in consolidating normal fuel. The operation of this system on abnormal fuel further demonstrated its capability to maintain identity of the fuel rods as they are inserted into the canister. In the rare case of a failed rod in commercial operation, the rod can be replaced by a dummy rod carrying locater information of the failed rod for accountability records. The Non-Fuel Bearing Compaction System is now patented and is theoretically capable of 18 to 1 reduction of non-fuel bearing waste. Using this system in conjunction with the fuel consolidation system confirms and supports the quoted price of $9.50/KgU now being offered by US Tool & Die, Inc. The canister used in the Battelle demonstration has been tested and is capable of sustaining drop accidents without bursting apart. This was a concern in the development of the ANSI 57.10 Standard.

45101 (PNL-SA—15094, pp 190-200) **RG & E/ESEERCO spent fuel consolidation and characterization project report.** (Rochester G and E Corp., NY). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45102 (PNL-SA—15094, pp 201-212) **Results of rod consolidation at West Valley.** Johnson, C.R. (Nuclear Assurance Corp., Norcross, GA). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45103 (PNL-SA—15094, pp 213-230) **Temperature limits for dry spent fuel storage.** Chin, B.A. (Auburn Univ., AL). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

Conclusions: (1) Current Cask Designs are not limited by predicted max storage temperatures. (2) Max initial dry storage temperatures are a function of initial clad stress and spent fuel age. (3) A simple procedure has been developed to calculate max storage conditions. (4) Temperature limit curves have been calculated for spent fuel ages of 5, 6, 7, 10 and 15 years.

45104 (PNL-SA—15094, pp 231-255) **Spent fuel oxidation test results.** Gilbert, E.R. (Pacific Northwest Lab., Richland, WA). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

After irradiation, up to one percent of the spent fuel rods in some batches of LWR spent fuel in storage contain cladding breaches. These rods present little impact on handling, unless the fuel becomes oxidized at cladding breach sites and is released as respirable size U_3O_8 powder. Receiving, packaging, and handling operations after pool storage and prior to emplacement that expose the fuel to heated air, present potential for fuel oxidation and the dispersal of radionuclides. Thus, a need for adequate data to permit prevention of excessive fuel oxidation is required to (1) limit fuel degradation during long term storage in air (NRC Docket under project No. M-46), (2) evaluate effects of abnormal events on spent fuel integrity, and (3) determine monitoring requirements to verify maintenance of an inert storage atmosphere. The oxidation behavior of three PWR (pressurized water reactor) and two BWR (boiling water reactor) spent fuel assemblies is being investigated. Bare spent fuel fragments, which simulate a worst case condition for stored fuel with a cladding breach, are being tested for periods up to two years in static air at temperatures of 135, 150, 170, 190, 210, and 230°C. A 10^5 R/h gamma field is imposed on sealed-oven atmospheres to simulate radiolysis of storage atmosphere gases. To date, the bare fuel tests have accumulated one-year exposure. Spent fuel rod segments with intentional defects are also included to develop an oxidation-level-to-cladding-strain correlation. These tests have recently been initiated.

45105 (PNL-SA—15094, pp 256-273) **International spent fuel storage update.** Johnson, A.B. Jr.; Silviera, D.J. (Pacific Northwest Lab., Richland, WA). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

Conclusions: (1) The development of spent fuel management strategies has benefited from international cooperation. (2) IAEA and NEA have provided effective forums for exchange of spent fuel management information. (3) Spent fuel storage will continue to be an important element of nuclear technology and will benefit from continued international cooperation. (4) National programs are described briefly on viewgraphs.

45106 (PNL-SA—15094, pp 274-281) **Storage economics overview.** Lambert, R.W. (Electric Power Research Inst., Palo Alto, CA). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

Recommended economic evaluation methodology: (1) Consider all economic factors. (2) Make sure all options evaluated using consistent methodology: suggest using $/KG. of net new space created; clearly spell out all assumptions. (3) Select an approximate discounting methodology and make sure that it is consistent with assumptions used for inflation: real rate of return, cost of capital, and opportunity cost.

45107 (PNL-SA—15094, pp 282-285) **Workshop on non-fuel bearing components.** 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

One of the clear messages that arose was the utilities' concern that DOE define what wastes it is going to accept under the NWPA and what it is not going to accept. A coincident, though secondary concern, was the effect of NRC's high-level waste definition. Until these issues are resolved, the utilities feel that they are hampered in their planning efforts with respect to handling of these wastes. With regard to the presentations, the attendees were afforded the opportunity to better understand the variety of waste types that must be dealt with and the difficulty of tracking them. This was of most interest to non-utility participants, since the utilities are generally involved with their specific waste quantities and types, and aren't affected by their neighbors problems. Others, such as DOE and NRC personnel, must concern themselves with the entire spectrum of waste hardware and hence require an overall, if not detailed, understanding. This includes an overview of the physical characteristics of the waste hardware as well as where it is, and its impact on the federal waste management system.

45108 (PNL-SA—15094, pp 286-294) **Waste characterization.** Luksic, A. (Pacific Northwest Lab., Richland, WA). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45109 (SAND—87-1917C) **Rigid performance requirements assure public safety by regulations.** Nickell, R.E.; Glass, R.E. (Applied Science and Technology, Poway, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870713—53). NTIS, PC A02. File Number DE87014159.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Title 10, Part 71 of the Code of Federal Regulations (10 CFR 71) provides a set of prescriptive performance test requirements for spent nuclear fuel and high-level waste transport packaging containment systems. The hypothetical accident conditions, which involve a sequence of impact, puncture, fire, and water immersion events, are referred to as rigid because of their extremely prescriptive nature. These hypothetical accident events have now been placed within the context of real transportation accidents, at least for conventional austenitic stainless steel/lead gamma shielded cask designs. The assurance of public safety, including the issue of safety margin for very severe accident events, is discussed in this paper for both conventional and innovative cask design concepts. A particular risk assessment approach that follows from work at the Lawrence Livermore National Laboratory is suggested. 6 refs., 2 figs.

45110 **(UNI-SA—198) Spent fuel pool cleanup and stabilization.** Miller, R.L. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01857. 18p. (CONF-871018—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012226.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Each of the plutonium production reactors at Hanford had a large water-filled spent fuel pool to provide interim storage of irradiated fuel while awaiting shipment to the separation facilities. After cessation of reactor operations the fuel was removed from the pools and the water levels were drawn down to a 5- to 10-foot depth. The pools were maintained with the water to provide shielding and radiological control. What appeared to be a straightforward project to process the water, remove the sediments from the basin, and stabilize the contamination on the floors and walls became a very complex and time consuming operation. The sediment characteristics varied from pool to pool, the ion exchange system required modification, areas of hard-pack sediments were discovered on the floors, special arrangements to handle and package high dose rate items for shipment were required, and contract problems ensued with the subcontractor. The original schedule to complete the project from preliminary engineering to final stabilization of the pools was 15 months. The actual time required was about 25 months. The original cost estimate to perform the work was $2,651,000. The actual cost of the project was $5,120,000, which included $150,000 for payment of claims to the subcontractor. This paper summarizes the experiences associated with the cleanup and radiological stabilization of the 100-B, -C, -D, and -DR spent fuel pools, and discusses a number of lessons learned items.

45111 **Response of spent LWR fuel to extreme environments.** Sandoval, R.P.; Burian, R.J.; Kok, K.D.; Balmert, M.E.; Freeman Kelly, R.; Fentiman, A.W. (Sandia National Labs., Albuquerque, NM; Battelle Columbus Labs., OH). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The research discussed deals with the radiological source term which could arise when irradiated fuel in transport from a commercial light water reactor is exposed to the extreme environments postulated for some transportation accidents, specifically those involving a fire. The release of spent fuel radionuclides to the environment requires a breach of both the cask and the fuel rod cladding. The quantity and characteristics of the radioactive material released from the fuel rods to the cask cavity as a result of such an event are estimated. Briefly, the objectives of this study were as follows. (1) Identify those conditions within a transportation cask which might produce fuel rod cladding failure, emphasizing conditions associated with fires. (2) Determine by experiment and analysis the nature of the source term so produced. Two literature surveys were conducted to deal with the first objective: the first survey was performed to examine the data on all mechanisms by which Zircaloy clad fuel rods might fail, the second to identify which failure mechanisms would most likely occur in a severe fire environment of an extraordinary transportation accident. The key findings of these surveys were as follows. (a) For fire temperatures and exposure times defined for licensing purposes by US Nuclear Regulatory Commission and IAEA regulations, no failures of fuel rods inside the cask are expected to occur. (b) The most likely fuel rod failure mechanism in a severe fire (800 deg. C < T <= 1200 deg. C for longer than two hours) would be a creep rupture failure induced by high temperatures and the pressure differential across the cladding. (c) There are considerable data relevant to creep rupture failure, but none which adequately characterize the associated radiological source term. (d) The lack of relevant radiological source term data indicates that experiments to characterize the source term better are justified. 6 references, 2 figures, 1 table.

45112 **TRUPACT containment issues.** Sandoval, R.P.; Sanchez, L.C. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The Transuranic Package Transporter (TRUPACT-I) is being developed to transport contact-handled transuranic (CH-TRU) wastes from defense waste-generation sites to repositories. Information is given on the research being performed in connection with technical areas in the TRUPACT-I development programme that are containment-related issues: (1) the physical and aerosol characteristics of the CH-TRU waste material available for release from TRUPACT-I to the environment as a result of hypothetical accident conditions (i.e., the source term); and (2) the generation and potential buildup of hydrogen gas produced by radiolysis from the waste material within the TRUPACT-I. 4 references, 5 figures.

45113 **Acoustic emission and wave propagation monitoring at the spent fuel test: Climax, Nevada.** Majer, E.L.; McEvilly, T.V. (Lawrence Berkeley Lab., CA). *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts;* **22**: No. 4, 215-226(1985).

For more than 3-1/2 years, transient acoustic emission events together with P- and S-wave velocities and amplitudes were monitored by a 15-station 1 to 10 kHz bandwidth seismographic network in a heated underground test repository. Automated seismic processing analyzed the transient events for location and source properties, while daily pulsing of a piezoelectric reference source provided precise measurement of changes in velocity and amplitude. The site was a spent fuel repository test facility 420m below ground in the Climax Stock quartz monzonite in Nevada, where spent fuel assemblies and heaters simulated repository conditions. Temperatures in the rock reached only 80°C, but produced abundant acoustic emission events and large changes in S-wave amplitudes. P-wave velocities and amplitudes were not affected by the heating or cool-down process. The effects seen are postulated to be due to crack closure and dewatering of the rock mass. 21 refs., 10 figs., 1 tab.

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REFER ALSO TO CITATION(S) 44981, 45076, 45092, 45107, 45108, 45113, 45336, 45419, 45422, 46232

45114 **(AD-A—181650/3/XAB) Recycle process for depleted-uranium machining chips by vacuum-induction remelt. Final report.** Latham-Brown, C.E.; Vanderkooi, D. (Nuclear Metals, Inc., Concord, MA (USA)). May 1987. 60p. NTIS, PC A04/MF A01.

The objective of the effort described in this report was to develop a method by which oxidized machining chips of depleted uranium, DU-3/4 titanium, generated in the production of large caliber penetrators, could be recycled as part of the charge in melting and casting of the alloy. The melting of this material was carried out by means of vacuum-induction techniques. The advantages of such a procedure could be the improvement of metal utilization, a reduction in the volume of scrap presently generated and, conse-

quently, a lowering of the direct cost of disposal. Recovery of such material would result in reduced penetrator manufacturing costs and in contract savings to the government.

45115 **(BMI/ONWI—634) Probable maximum flood analysis, Richton Dome, Mississippi-Phase I: Technical report.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1987. Contract AC02-83CH10140. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008915.

This report presents results of a preliminary analysis of the extent of inundation that would result from a probable maximum flood (PMF) event in the overdome area of Richton Dome, Mississippi. Bogue Homo and Thompson Creek watersheds drain the overdome area. The US Army Corps of Engineers' HEC-1 Flood Hydrograph Package was used to calculate runoff hydrographs, route computed flood hydrographs, and determine maximum flood stages at cross sections along overdome tributaries. The area and configuration of stream cross sections were determined from US Geological Survey topographic maps. Using maximum flood stages calculated by the HEC-1 analysis, areas of inundation were delineated on 10-ft (3-m) contour interval topographic maps. Approximately 10% of the overdome area, or 0.9 mi^2 (2 km^2), would be inundated by a PMF event. 34 refs., 3 figs., 1 tab.

45116 **(DOE/OR/00033—T314) Radioactive Waste Management Fellowship Program: Summary of program activities for calendar year 1986.** (Oak Ridge Associated Universities, Inc., TN (USA)). 1987. Contract AC05-76OR00033. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009954.

This document describes a graduate fellowship program designed to guide future scientists and engineers toward a career in high level radioactive waste management. Oak Ridge Associated Universities administers this program on behalf of 17 participating universities. The report summarizes the background and qualifications of the last year's applicants and awardees and provides examples of the distributed literature describing the program. 8 figs. (TEM)

45117 **(DOE/TIC—3406) Nevada Nuclear Waste Storage Investigations, 1977-1985: A bibliography.** McLaren, L.H.; Lorenz, J.J. (comps.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jun 1987. 342p. (NVO—196-24(Rev.6)). NTIS, PC A15. File Number DE86013045.

This bibliography contains information on the Nevada Nuclear Waste Storage Investigations (NNWSI) that was added to the Department of Energy's Energy Data Base from January 1977 through December 1985. A brief history is included to familiarize the reader with the general direction and activity highlights of the NNWSI and to give the reader some insight into the kinds of bibliographic references to be found in this document. The bibliography is categorized by principal NNWSI participant organizations. Participant-sponsored subcontractor reports, papers, and articles are included in the sponsoring organization's bibliography list. The principal participant bibliography listings are arranged in chronological order. The following indexes are provided: Corporate Author, Personal Author, Subject, Contract Number, Report Number, Order Number Correlation, and Key Word in Context. Six-month updates to this bibliography will not have indexes. The updates will be cumulated and issued at 2-year intervals as a supplement to the original bibliography. The supplement will include all the indexes.

45118 **(DP-MS—87-27) Shielded cell and radiobench procedures for analyzing radioactive defense waste.** Scott, W.H. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 29p. (CONF-870802—13). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012920.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The Defense Waste Processing Facility (DWPF) is being constructed at Savannah River Plant. DWPF includes laboratory facilities for process control analyses. Analytical methods required for DWPF support are listed. Work done to implement analytical methods in the shielded cells is discussed: Fe(II)/Fe(III) ratio in DWPF glass; solids content; and automated titration for acids, bases, and chlorides. (DLC)

45119 **(DP-MS—87-32-Rev.1) Leaching of saltstone: Laboratory and field testing and mathematical modeling.** Grant, M.W.; Langton, C.A.; Oblath, S.B.; Pepper, D.W.; Wallace, R.M.; Wilhite, E.L.; Yau, W.W.F. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 41p. (CONF-870802—14-Rev.1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014197.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

A low-level alkaline salt solution will be a byproduct in the processing of high-level waste at the Savannah River Plant (SRP). This solution will be incorporated into a wasteform, saltstone, and disposed of in surface vaults. Laboratory and field leach testing and mathematical modeling have demonstrated the predictability of contaminant release from cement wasteforms. Saltstone disposal in surface vaults will meet the design objective, which is to meet drinking water standards in shallow groundwater at the disposal area boundary. Diffusion is the predominant mechanism for release of contaminants to the environment. Leach testing in unsaturated soil, at soil moisture levels above 1 wt %, has shown no difference in leach rate compared to leaching in distilled water. Field leach testing of three thirty-ton blocks of saltstone in lysimeters has been underway since January 1984. Mathematical models were applied to assess design features for saltstone disposal. One dimensional infinite-composite and semi-infinite analytical models were developed for assessing diffusion of nitrate from saltstone through a cement barrier. Numerical models, both finite element and finite difference, were validated by comparison of model predictions with the saltstone lysimeter results. Validated models were used to assess the long-term performance of the saltstone stored in surface vaults. The maximum concentrations of all contaminants released from saltstone to shallow groundwater are predicted to be below drinking water standards at the disposal area boundary. 5 refs., 11 figs., 5 tabs.

45120 **(DP-MS—87-80) Performance assessment methods for mixed waste sites at the Savannah River Plant.** King, C.M.; Marter, W.L.; Looney, B.B.; Pickett, J.B.; Till, J.E.; Meyer, K.R.; Merrel, G.C.; Rogers, V.C.; Holton, G.A.; Montague, D.F. (Savannah River Lab., Aiken, SC (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant; Radiological Assessments Corp., Neeses, SC (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA); JBF Associates, Knoxville, TN (USA)). 1987. Contract AC09-76SR00001. 26p. (CONF-870859—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014201.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Risk assessment techniques were applied to Savannah River Plant (SRP) waste facilities as part of a program on waste site cleanup and groundwater protection. The components of risk assessment and the technical basis for application of the risk evaluation process to the principal pollutants at SRP (radionuclides, toxic chemicals, and carcinogenic compounds) are given. An extensive technical data base from the fields of radiation health physics, toxicology, and environmental sciences is required. Data are summarized for each class of contaminant and parameter values are provided for use in numerical analysis of risk. A review of risk assessment uncertainties and the limitations of predictive risk assessment are summarized. Risk estimators for each class of contaminants at the SRP were tabulated for radionuclides, toxic chemicals, and carcinogens from the technical literature. Estimation of human health risk is not an additive process for radiation effects and chemical carcinogensis since their respective dosimetric models are distinctly different - even though the induction of cancer is reported to be the common end result. Risk estimation for radionuclides and chemical carcinogens should be tabulated separately. Impacts due to toxic chemicals in the biosphere should also be estimated as a separate entity because toxic chemical risk estimators are uniquely different and do not reflect the probability of a detrimental health effect. 29 refs., 3 figs., 2 tabs.

45121 **(DP-MS—87-87) Greater Confinement Disposal trench and borehole operations status.** Harley, J.P. Jr.; Wilhite, E.L.; Jaegge, W.J. (Savannah River Lab., Aiken, SC (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 6p. (CONF-870859—2-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012385.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Greater Confinement Disposal (GCD) facilities have been constructed within the operating burial ground at the Savannah River Plant (SRP) to dispose of the higher activity fraction of SRP low-level waste. GCD practices of waste segregation, packaging, emplacement below the root zone, and waste stabilization are being used in the demonstration. 2 refs., 2 figs., 2 tabs.

45122 **(EGG—10282-1113) An aerial radiological survey of Areas 12, 15, 17 and 19, Nevada Test Site: Date of survey: October-November 1984.** Jobst, J.E. (EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.). Oct 1986. Contract AC08-83NV10282. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014324.

Airborne measurements were obtained over Areas 12, 15, 17, and 19. The data were used to obtain gross count and cesium-137 spatial distribution maps. The survey results are expressed as exposure rate isopleths and cesium-137 concentrations, superimposed on NTS maps. 11 refs., 20 figs.

45123 **(FMPC—2095-Special) Biodenitrification demonstration test report.** Benear, A.K.; Murray, S.J.; Lahoda, E.J.; Leslie, J.W.; Patton, J.B.; Menako, C.R. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). Aug 1987. Contract AC05-86OR21600. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014153.

A two-column biodenitrification (BDN) facility was constructed at the Feed Materials Production Center (FMPC) in 1985 and 1986 to test the feasibility of biological treatment for industrial nitrate-bearing waste water generated at FMPC. This demonstration facility comprises one-half of the proposed four-column production facility. A demonstration test was conducted over a four month period in 1987. The results indicate the proposed BDN production facility can process FMPC industrial wastewater in a continuous manner while maintaining an effluent that will consistently meet the proposed NPDES limits for combined nitrate nitrogen (NO_3-N) and nitrite nitrogen (NO_2-N). The proposed NPDES limits are 62 kg/day average and 124 kg/day maximum. These limits were proportioned to determine that the two-column demonstration facility should meet the limits of 31 kg/day average and 62 kg/day maximum.

45124 **(INIS-mf—10660) Hydrofrac characteristics of saline rock as a function of salt species, pressure, and rate of pressure increase.** Schlueter, K. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 2 Jun 1986. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE87752469.

The author investigates the conditions in which the storage of liquids in salt caverns can be assumed to be safe. Experiments on hollow salt cylinders and salt cubes were to establish conservative limiting values for the suitable storage conditions. The experiments, owing to the small size of the test specimens and to their preparatory treatment, resulted in a somewhat lower strength of the salt than would have been measured in situ.

45125 **(KFK—4258) Encapsulation of noble gas in zeolites.** Dorea, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). Apr 1987. 118p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-10827.

The noble gases neon, argon, krypton and xenon were encapsulated hydrothermally as pure gases as well as in the form of mixtures in type A zeolite of various cationic compositions. As opposed to the starting material the encapsulates are X-ray amorphous and posess a very small specific surface area. Irrespective of the thermal pretreatment of the zeolites the optimal loading occured within a certain temperature window. The amount of gas trapped was essentially a function of the fixation pressure. Within the pressure range 50-2200 bar the obtained loading was independent from the type of noble gas. When mixtures of noble gases were encapsulated a small enrichment of the heavier noble gas, caused by kinetic and thermodynamic effects, was observed. The thermal stability of the encapsulates was found to be very high. Even at temperatures as high as 750/sup 0/C a recrystallization to anorthite was only observed after practically all the trapped gas had been released. Experiments destined to clarify the mechanism of gas leckage at temperatures below 750/sup 0/C suggest a diffusion controlled mechanism described by a $\sqrt{t}$ law. Even at loadings of 45 ml/(STP) Kr/g the leckage predicted under conditions as expected during longterm storage of Kr-85 is extremely small. Kinetic data demonstrate that the gas is not trapped in the form of agglomerates but rather exists homogeneously distributed within the encapsulate. This result is substantiated by electron beam microanalysis.

45126 **(LA-UR—87-1773) TA-2 Water Boiler Reactor (Phase I) decommissioning: Resolving ground water interference during outdoor component removal and soil decontamination.** Elder, J.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-871018—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010133.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Extensive ground water was encountered in excavations as structures, pipe, and soil contaminated with Cs-137 were removed during the outdoor phase (Phase I) of the TA-2 Water Boiler Reactor decommissioning. To avoid releasing contamination to a nearby surface stream, contaminated soil and water pumped or scooped into secondary pits above the level of ground water interference. These pits served as holding tanks/natural filters because high soil pH in the area enhanced attachment of Cs-137 to soil particles. Water seeped out of the secondary pits, leaving contaminated soil behind to easily scraped from the surfaces of the pit. Stabilization and revegetation of the area, complemented by a long-term environmental surveillance program, has resulted in successful closure, although total removal of all contamination was not possible. 3 refs., 5 figs.

45127 (NP—7900797, pp 73-75) **Nondestructive techniques for evaluating the integrity of vitrified solids III.** Sano, Akira; Uchida, Katsuya; Sugimura, Koji; Matsuda, Kazunori; Murata, Toru; Kakuta, Akio; Sasaki, Noriaki; Ikeda, Satoshi. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.; Power Reactor and Nuclear Fuel Development Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

High level radioactive liquid wastes discharged from a fuel reprocessing plant are planned to be incorporated in borosilicate glass as a vitrified solid. From the standpoint of radioactivity management of the vitrified solid during transportation and storage, it is necessary to obtain the information on total radioactivity, density and homogeneity of the vitrified solid. To meet the above requirement, we are developing the nondestructive inspection techniques for the vitrified solid based on computed tomography (CT) and γ-scanning techniques. Transmission computed tomography (TCT) and emission computed tomography (ECT) techniques were theoretically studied in 1980, and the results were verified by experiments with small non-radioactive vitrified solids of 76 mm diameter in 1981. In the present study, an experimental instrument for non-radioactive samples of 430 mm diameter was designed and constructed. The applicability of TCT, ECT and transmission-type γ-scanning techniques was examined with mocked aluminum samples and non-radioactive vitrified solids of 430 mm diameter.

45128 (NP—7900797, pp 76-77) **Passive neutron assay of plutonium contaminated wastes.** Higuchi, Shin-ichi; Sano, Akira; Matsuda, Kazunori; Kawai, Akio; Tamura, Toshiyuki; Matsuda, Yasuhiko; Kobayashi, Kiichi; Matsubayashi, Toshiyuki; Izuhara, Shigeomi; Suzuki, Masahiro. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.; Power Reactor and Nuclear Fuel Development Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

In nuclear fuel facilities, it is desired to classify plutonium contaminated wastes in order to perform the effective management for a large amount of wastes. To meet the above requirement, a passive neutron assay system for 20 l carton box wastes was constructed and its performances such as detectability limit and accuracy were evaluated. This report details the system description and performance.

45129 (NP—7900797, pp 78) **Direct measuring system of radioactivity in the low level drum package.** Sumida, Yukio; Nakamura, Hitoshi; Ohigashi, Yoshiaki. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Concentrated liquid wastes generated from nuclear facilities are solidified with cement or asphalt to pack into a 200 l drum. If packages may be treated by means of final disposal, it is required to identify the nuclides and determine those activities in each package. Nowadays in any nuclear facility identification and determination of them are performed by sampling of the solution before solidification. But those methods are not proper in case of difficulties of homogeneous solution sampling, or uncertainties of history of a package. The direct measuring system has been developed to solve these difficulties.

45130 (NP—7900797, pp 86-88) **Technical development of spent resins volume reduction system by inorganization method: Advanced oxidative decomposition.** Ichihashi, Toshio; Hasegawa, Akira; Matsuura, Hiroyuki. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Recent progress of energy dependence on nuclear power has resulted in an acceleration of radioactive wastes generation, and a guide line of the final disposal method of radioactive wastes is not completely confirmed in Japan. Therefore, most of the radioactive wastes have been packaged in drums and stored on sites of nuclear power stations without any treatment. The volume of radioactive wastes and the number of the drums are remarkably increasing. Spent ion exchange resins occupy the major component of radioactive wastes in nuclear power stations, and therefore, the volume reduction of them reduces the total amount of wastes efficiently. Oxidative decomposition method using hydrogen peroxide solution with ferric ion as catalyst has been found excellent in decomposing the spent ion exchange resins. But the disadvantage of this system is the inferiority of the volume reductivity in comparison with the dry combustion system. We tried to develop a new and advanced volume reduction system.

45131 (NP—7900797, pp 91-92) **Development of a hollow fiber for liquid waste treatment.** Ohigashi, Yoshiaki; Shirai, Takamori; Shoji, Yuichi; Yamada, Kazuya; Tajima, Fumio. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

A precoat-type filter has been used so far in BWR radwaste treatment system to remove suspended solids. The filter requires, however, the large quantity of filter aid which causes additional waste generation. Another concern is the effluent water quality that has affected chemical forms of suspended solids. The forms hard to remove are sometimes found in low conductivity waste water which includes backwashed water from condensate filter system. One of the forms is assumed as amorphous ferric compound. To alleviate these shortcomings, a hollow fiber has been developed with the following objectives: to improve effluent water quality; to minimize quantities of solid waste generated; to improve filter reliability and availability; to reduce the initial cost and the running cost.

45132 **(PNL—6152) Long-term performance assessment of grouted phosphate/sulfate waste from N Reactor operations.** Sewart, G.H.; Farris, W.T.; Huizenga, D.G.; McMakin, A.H.; Streile, G.P.; Treat, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 99p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87008860.

Phosphate sulfate waste (PSW) is a low-level liquid generated by activities associated with N Reactor operations. The waste will be mixed with dry solids and permanently disposed of as a cementitious grout in sub-surface concrete vaults at Hanford's 200-East Area. Categories of scenarios were analyzed that could cause humans to be exposed to radionuclides and chemicals from the grouted waste include contaminated groundwater and direct intrusion. In the groundwater scenario, contaminants are released from the buried grout monoliths, then eventually transported via the groundwater to the Columbia River. As modeled, the contaminants are assumed to leach out of the monoliths at a constant rate over a 10,000-year period. The other category of exposure involves intruders who inadvertently contact the waste directly, either by drilling, excavating, or gardening. Long-term impacts that could result from disposal of PSW grout were expressed in terms of incremental increases of chemical concentrations in the groundwater and surface waters, and radiation doses. None of the calculated impacts exceeded the corresponding regulatory limits set by Washington State, the Department of Energy, or the Nuclear Regulatory Commission. 38 refs., 17 figs., 27 tabs.

45133 (PNL-SA—15094, pp 295-316) **Office of Civilian Radioactive Waste Management (OCRWM), Waste Systems Data Development (WSDD) Program: Waste characterization subtask.** Moore, R.S. (Maxima Corp., Oak Ridge, TN). 1987. NTIS, PC A14/MF A01. File Number DE87012683. (CONF-8705162—Vugraphs).

From Spent fuel storage technical exchange meeting; Washington, DC, USA (12 May 1987).

45134 **(PTB-SE—13) Simplified method of checking the observance of maximum permissible activity of waste forms to be placed in the Konrad shaft for final waste storage.** Berg, H.P.; Piefke, F. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Sicherstellung und Endlagerung Radioaktiver Abfaelle). Oct 1986. 26p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-10415.

The requirements to be met by waste forms destined for final storage in the Konrad shaft among others define maximum permissible activity levels which have been determined from the various parts of the safety analyses. For waste forms with very low activity levels, it is suitable to compile all the very specific requirements in one checking list, and to perform the checking as simply as adequate. On the basis of the compilation of requirements defined for normal operation of the storage facility, hypothetical accidents, thermal loads affecting the host rock, and criticality safety, the maximum permissible activities are derived that are to be checked by the simplified control measures explained. The report explains the computer programs for the ANKONA code.

45135 **(RHO-RE-SA—181-P) Alternatives to disposal of Hanford Site liquid effluents to the soil column.** Meinhardt, C.C.; Flyckt, D.L.; Wirsing, R.M.; Winterhalder, J.A. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1987. Contract AC06-77RL01030. 20p. (CONF-870306—64). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010687.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Alternative systems were selected for 28 effluent streams, based on the use of available technology and ability to eliminate the contaminated effluent or reduce contaminant levels to meet specified effluent disposal criteria and standards derived from DOE Orders and environmental statutes. This study determined that technically feasible alternative waste disposal systems are available. 6 refs., 2 figs., 2 tabs.

45136 (SAAS—344, pp 35-43) **Evaluation of the radiological safety in storing and processing of liquid and solid radioactive wastes from nuclear power stations.** Belitskij, A.S.; Pavlovskij, O.A.; Stepanova, V.D.; Smirennaya, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780163. (CONF-8509389—Pt.4).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

Possible releases from the repository of liquid radioactive wastes, originating from different type reactors, into the biosphere has been evaluated. Experimental data on the radioactive wastes and geohydrological data on the reactor site allow an assessment of the radiological risks in the case of leakage of the repository. The rate of migration of radioactive wastes in rocks has been determined by ion exchange absorption and a mathematical model. Individual procedures for final disposal of liquid and solidified radioactive wastes from nuclear power stations in the lithosphere are presented.

45137 **(SAND—86-0611) Basic data report for drilling and hydrologic testing of drillhole DOE-2 at the Waste Isolation Pilot Plant (WIIP) site.** Mercer, J.W.; Beauheim, R.L.; Snyder, R.P.; Fairer, G.M. (Sandia National Labs., Albuquerque, NM (USA); Geological Survey, Denver, CO (USA)). Apr 1987. Contract AC04-76DP00789. 332p. NTIS, PC A15. File Number DE87009350.

Drillhole DOE-2 was drilled to investigate a structural depression marked by the downward displacement of stratigraphic markers in the Salado Formation. Contrary to several hypotheses, halite layers were thicker in the lower part of the Salado, not thinner as a result of any removal of halite. The upper Castile anhydrite in Drillhole DOE-2 is anomalously thick and is strongly deformed relative to the anhydrite in adjacent drillholes. In contrast, the halite was <8 ft thick and significantly thinner than usually encountered. The lower Castile anhydrite appears to be normal. The depression within the correlated marker beds in the Salado Formation in Drillhole DOE-2 is interpreted as a result of gravity-driven deformation of the underlying Castile Formation. Several stratigraphic units were hydrologically tested in Drillhole DOE-2. Testing of the unsaturated lower portion of the Dewey Lake Red Beds was unsuccessful because of exceptionally small rates of fluid intake. Drill-stem tests were conducted in five intervals in the Rustler Formation, over the Marker Bed 138-139 interval in the Salado formation, and over three sandstone members of the Bell Canyon Formation. A pumping test was conducted in the Culebra Dolomite Member of the Rustler Formation. Pressure-pulse tests were conducted over the entire Salado Formation. Fluid samples were collected from the Culebra Dolomite Member and from the Hays Member of the Bell Canyon Formation. 31 refs., 31 figs., 5 tabs.

45138 **(SAND—86-7134C) Numerical modeling of isothermal and nonisothermal flow in unsaturated fractured rock: A review.** Pruess, K.; Wang, J.S.Y. (Lawrence Berkeley Lab., CA (USA)). 1986. Contract AC04-76DP00789;AC03-76SF00098. 43p. (LBL—22773; CONF-861220—7). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010516.

From American Geophysical Union fall meeting; San Francisco, CA, USA (8 Dec 1986).

The tuff formations at and near the Nevada Test Site are comprised of fractured-porous material, with hydrologic properties quite different from those encountered in most previous unsaturated flow studies dealing with soils. In the vicinity of the waste packages, flow is driven by high temperatures (exceeding 100°C) and large temperature gradients. The approximations developed in soil science for weakly nonisothermal flow are not applicable to this situation, and a multiphase description of flow is required, similar to approaches used in modeling of geothermal reservoirs and thermally enhance oil recovery. The conventional approach to unsaturated flow is applicable, however, to a variety of problems relating to natural (undisturbed) and far-field flow conditions. This paper reviews recent work on numerical modeling of unsaturated flow undertaken in the context of nuclear waste isolation studies. Concepts and applications of broader interest are summarized, and important issues are identified that have not been adequately explored. 84 refs, 8 figs.

45139 **(SAND—87-0879) Scoping model calculations of the reconsolidation of crushed salt in WIPP shafts.** Nowak, E.J.; Stormont, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013413.

Scoping model calculations show that crushed salt seal material can reconsolidate in a WIPP shaft to densities and permeabilities that are nearly equal to those for intact WIPP host rock salt. Crushed salt in the lower one-third of a WIPP shaft will meet our criterion of acceptability for shaft sealing in less than 200 years. The extent of expected reconsolidation was shown to be sensitive to the rates of brine inflow from overlying water bearing zones and from the WIPP host rock salt. Reconsolidation was also found to be sensitive to predictions of closure within our current range of uncertainty. Reconsolidation was found to be relatively insensitive to the initial void fraction within the practically achievable range (0.15 to 0.3) and to the time delay from shaft excavation to crushed salt emplacement. An effective upper shaft seal system is needed to protect the reconsolidating crushed salt from brine inflow for approximately 200 years. It is important for the evaluation of shaft seal performance to have more accurate, thoroughly tested models for brine influx from WIPP host rock and for shaft closure. 13 refs., 15 figs.

45140 **(UCID—20442) Preliminary report of the past and present uses, storage, and disposal of hazardous materials at the Lawrence Livermore National Laboratory.** Dreicer, M. (Lawrence Livermore National Lab., CA (USA)). Dec 1985. Contract W-7405-ENG-48. 251p. NTIS, PC A12. File Number DE87013075.

This report contains the findings of a records search performed to survey the past and present use, storage, and disposal of hazardous materials and wastes at the Lawrence Livermore National Laboratory (LLNL) site. This report provides a point of departure for further planning of environmental protection activities at the site. This report was conducted using the LLNL archives and library, documents from the US Navy, old LLNL Plant Engineering blueprint files, published articles and reports, Environmental Protection Program records, employee interviews, and available aerial photographs. Sections I and II of this report provide an introduction to the LLNL site and its environmental characteristics. Several tenants have occupied the site prior to the establishment of LLNL, currently operated by the University of California for the US Department of Energy. Section III of this report contains information on environmentally related operations of early site users, the US Navy and California Research and Development. Section IV of this report contains information on the handling of hazardous materials and wastes by LLNL programs. The information is presented in 12 sub-sections, one for each currently operating LLNL program. General site areas, i.e., garbage trenches, the traffic circle landfill, the taxi strip, and old ammunition bunkers are discussed in Section V. 12 refs., 23 figs., 27 tabs.

45141 **(UCRL—53728) Post-test thermal calculations and data analyses for the Spent Fuel Test, Climax.** Montan, D.N.; Patrick, W.C. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013822.

After the Spent Fuel Test - Climax (SFT-C) was completed, additional calculations were performed using the best available (directly measured or inferred from measurements made during the test) input parameters, thermal properties, and power levels. This report documents those calculations and compares the results with measurements made during the three-year heating phase and six-month posttest cooling phase of the SFT-C. Three basic types of heat-transfer calculations include a combined two-dimensional/three-dimensional, infinite-length, finite-difference model; a fully three-dimensional, finite-length, finite-difference model; and a fully three-dimensional, finite-length, analytical solution. The finite-length model much more accurately reflects heat flow near the ends of the array and produces cooler temperatures everywhere than does its infinite-length counterpart. 14 refs., 144 figs., 4 tabs.

45142 (ZfI-Mitt—122, pp 85-124) **Error evaluation for the numerical integration of special stiff differential equation systems.** Zieger, K. Nov 1986. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

The composition of nuclear fuel in the operational or decay phase can be determined by the numerical integration of a stiff differential equation system. The analytic study of the approximation accuracy is limited to a prototype of reaction equations. Based on a fitted error definition, a practical error evaluation method is proposed, which could not be derived in the strict sense.

45143 **Stochastic analysis of contaminant transport in porous media: analysis of a two-member radionuclide chain.** Bonano, E.J.; Shipers, L.R. (Sandia National Labs., Albuquerque, NM). *Water Resources Research;* **23**: No. 6, 1063-1078(Jun 1987). Contract AC04-76DP00789.

In this study the authors extend previous stochastic analyses of contaminant transport in geologic media for a single species to a chain of two species. The authors particular application is the quantification of uncertainties due to lack of characterization of the spatial variability of hydrologic parameters on transport of radionuclides from a high-level waste repository to the biosphere. Radionuclide chains can have a significant impact on demonstrating compliance (or violation) of standards regulating the release to the environment accessible to humans. Two approaches for determining the cross-covariance terms in the mean concentration equations are presented. One uses a Taylor expansion to obtain the cross-covariance between the velocity and concentration fluctuations, while the other is based on a Fourier-Laplace double transform method. For the conditions of interest here, the difference between these two approaches are expected to be small. In addition, the variances are calculated in a unique way by solving another associated partial differential equation. A parametric study is carried out to examine the sensitivity of the mean concentration of the two species and their corresponding variances and cross-covariance on the parameters associated with the structure of the stochastic velocity field. It is found that the dependent variables are most sensitive to the intensity and correlation length of the velocity fluctuations. The magnitude of the variances and cross-covariance of the concentrations are proportional to the magnitude of the mean concentrations which depend on inlet concentration boundary conditions.

45144 **Flow equations in terms of piezometer levels for nonisothermal fluid in low-permeability porous medium.** Lu, A.H.; Sagar, B.; Guerrther, R.B.; Hudspeth, R.T. (Rockwell Hanford Operations, Richland, WA). *Water Resources Research;* **23**: No. 6, 1097-1102(Jun 1987). Contract AC06-77RL01030.

The Basalt Waste Isolation Project is investigating deep basalt flows for the disposal of high-level nuclear wastes. The time spans of interest are so long that site performance must be projected by mathematical modeling. At great depths, velocity potentials determined simply by using the gradients of piezometric levels (i.e., neglecting the temperature dependence) may cause some errors. In this paper, flow equations are written in terms of the piezometric level as the dependent variable, so that model input and output are in terms of directly measured field data. For nonisothermal flow, a nonlinear governing equation in obtained. Under certain assumptions on the functional representation of fluid density, a scalar potential can be defined. A simple example is presented to demonstrate the methodology to obtain such a potential. Improvement in calculating the downhole pressures from water level data is also discussed.

45145 **Automated sensitivity analysis: New tools for modeling complex dynamic systems.** Pin, F.G. (Oak Ridge Nat'l Lab., Oak Ridge, TN). pp 305-312 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

Sensitivity analysis is an established methodology used by researchers in almost every field to gain essential insight in design and modeling studies and in performance assessments of complex systems. Conventional sensitivity analysis methodologies, however, have not enjoyed the widespread use they deserve considering the wealth of information they can provide, partly because of their prohibitive cost or the large initial analytical investment they require. Automated systems have recently been developed at ORNL to eliminate these drawbacks. Compilers such as GRESS and EXAP now allow automatic and cost effective calculation of sensitivities in FORTRAN computer codes. In this paper, these and other related tools are described and their impact and applicability in the general areas of modeling, performance assessment and decision making for radioactive waste isolation problems are discussed.

45146 **Processing and disposal of defense nuclear waste at the Savannah river plant.** Wilhite, E.L.; Ebra, M.A.; Stone, J.A.; Stevens, W.R. III. (E.I. du Pont de Nemours and Co., Aiken, SC). pp 648-658 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

High-level nuclear wastes are stored in large underground tanks at the Savannah River Plant. Processing of the wastes for ultimate disposal will begin in 1988. Nuclear wastes will be processed to separate the high-level radioactive fraction from the low-level fraction. The separation will be made in existing waste tanks by a process combining precipitation, adsorption, and filtration. The high-level fraction will be vitrified into borosilicate glass in the Defense Waste Processing Facility (DWPF) for disposal in a federal repository. The low-level fraction (decontaminated salt solution) will be mixed with a cement-fly ash blend. The resulting product, "saltstone," will be disposed of onsite by emplacement in an engineered facility. Waste properties, disposal facility details, and waste-form characteristics will be presented. Results of a field test of contaminant release from saltstone and modeling studies to predict release are described.

45147 **Overview: Defense high-level waste technology program.** Shupe, M.W.; Turner, D.A. (DOE, Richland, WA). pp 296 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

Defense high-level waste generated by atomic energy defense activities is stored on an interim basis at three U.S. Department of Energy (DOE) operating locations; the Savannah River Plant in South Carolina, the Hanford Site in Washington, and the Idaho National Engineering Laboratory in Idaho. Responsibility for the permanent disposal of this waste resides with DOE's Office of Defense Waste and Transportation Management. The objective of the Defense High-Level Wast Technology Program is to develop the technology for ending interim storage and achieving permanent disposal of all U.S. defense high-level waste. New and readily retrievable high-level waste are immobilized for disposal in a geologic repository. Other high-level waste will be stabilized in-place if, after completion of the National Environmental Policy Act

(NEPA) process, it is determined, on a site-specific basis, that this option is safe, cost effective and environmentally sound. The immediate program focus is on implementing the waste disposal strategy selected in compliance with the NEPA process at Savannah River, while continuing progress toward development of final waste disposal strategies at Hanford and Idaho. This paper presents an overview of the technology development program which supports these waste management activities and an assessment of the impact that recent and anticipated legal and institutional developments are expected to have on the program.

45148 **Hanford defense wastes: A program review.** Shupe, M.R.; De Figh-Price, C. (DOE, Richland, WA). pp 297-304 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

The Hanford Site currently has in storage a large percentage of the total volume of radioactive defense waste in the United States. Facilities presently operating and those planned in the future continue to produce high-level, low-level, and transuranic (TRU) waste that will require final disposal. The waste types and compositions vary widely because of the many diverse processes operated at Hanford since the early 1940's. This diversity results in an extensive interim management program and complex final disposal operation. The Defense Waste Management Plan (DWMP) (DOE, 1983) describes the national policy set forth for disposal of defense waste. The Interim Hanford Waste Management Plan (HWMP) (DOE, 1986a) expands on the Hanford portion of the DWMP and provides a proposed reference plan for the safe management and final disposal of existing and future wastes. Waste at Hanford is divided into six categories to identify the optimum disposal method for each, including single-wall tank waste, double-wall tank waste, contaminated soil sites, stored and new TRU solid waste, solid waste burial sites, and encapsulated byproducts, Cesium and Strontium. Highest priority is given to disposal of double-wall tank waste to minimize the need for new tank construction and dispose of future wastes as quickly after their production as practical. Stored and new solid TRU wastes are next in priority. Established national policy has already identified the Waste Isolation Pilot Plant (WIPP) for the potential disposal of TRU waste. Hanford disposal plans are being formulated to fit within the scope of the national policy. Single-wall tank wastes, contaminated soil sites, solid waste burial sites, and byproduct capsules are currently monitored and are considered to be stable and safe for several decades or longer.

45149 **Measurement of displacements in large boreholes with a strain-gauged proving ring.** Patrick, W.C.; Rector, N.L. (Lawrence Livermore National Lab., CA). *Experimental Techniques;* **9**: No. 2, 17-19(1985).

A strain-gauged proving-ring transducer was designed and deployed to measure small diametral displacements in 0.61-m diameter by 4.9-m deep boreholes in rock. The rock surrounding the boreholes was previously heated by storage of spent nuclear fuel assemblies and electrical resistance heaters. Borehole displacement measurements were made subsequent to removal of the spent fuel assemblies to document the rock response and to provide data for comparison with thermal-stress calculations. A transducer was designed to measure displacements in the range of 10 to 100 μm, to function in a time-varying temperature regime of 30° to 60°C at a relative humidity of 100%, to be of low stiffness, and to be easily and quickly installed. The strain-gauged proving-ring technology provided a viable means of recording displacements in large (0.61 m) diameter boreholes in rock which are subjected to a time-varying thermal field. Design of a relatively simple transducer to measure borehole displacements was moderately successful. Inadquate environmental protection of the strain gauges resulted in 6 of 14 transducers failing with a mean life of 85 days. The surviving transducers performed adequately, based on comparisons of pretest and post-test calibration results. 5 refs., 3 figs., 1 tab.

45150 **Low-level radioactive waste management technology development.** Coleman, J.A. (Div. of Storage and Treatment Projects, U.S. Dept. of Energy, Washington, DC 20545). pp 10-14 of Management of radioactive materials and wastes: Issues and progress. Majumdar, S.K.; Miller, E.W. Easton, PA; The Pennsylvania Academy of Science Publications (1985).

Although reviews of disposal practices and site performance indicated that there were no releases to the environment that would affect public health and safety, it became clear that: (a) several burial grounds were not performing as expected; (b) long-term maintenance of closed trenches could be a costly problem, and (c) more cost-effective methods could be developed for the treatment, packing, and disposal of low-level waste. As a result of these reviews, the Department of Energy developed the Low-level Waste Management Program to seek improvements in existing practices, correct obvious deficiencies, and develop site closure techniques that would avoid expensive long-term maintenance and monitoring. Such technology developments provide a better understanding of the physical and technical mechanisms governing low-level waste treatment and disposal and lead to improvement in the performance of disposal sites. The primary means of disposal of low-level waste has been the accepted and regulated practice of shallow land disposal, i.e., placement of low-level waste in trenches 5 to 10 meters deep with several meters of special soil cover. Department of Energy waste is primarily disposed at six major shallow land disposal sites. Commercial waste is currently disposed of at three major sites in the nation - Barnwell, South Carolina; Richland, Washington; and Beatty, Nevada. In the late 1970's public concern arose regarding the management practices of sites operated by the civilian sector and by the Department of Energy.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 45080, 45115, 45119, 45120, 45121, 45122, 45126, 45132, 45135, 45138, 45139, 45140, 45143, 45144, 45147, 46186, 46191, 46202, 46227, 46228, 46229, 46230, 46231

45151 **(EGG—10282-1136) An aerial radiological survey of the White Oak Creek Floodplain, Oak Ridge Reservation, Oak Ridge, Tennessee: Date of survey: September-October 1986.** Fritzsche, A.E. (EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.). Jun 1987. Contract AC08-83NV10282;AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014325.

An aerial radiological survey was conducted over the White Oak Creek Floodplain of the Oak Ridge Reservation during the period 30 September through 3 October 1986. The survey was performed at the request of the United States Department of Energy (DOE), Oak Ridge Operations Office, by EG & G Energy Measurements, Inc. (EG & G/EM), a contractor of the DOE. The survey results will be utilized in support of the Remedial Action Program being conducted at the site by Martin Marietta Energy Systems, Inc., operator of the Oak Ridge National Laboratory (ORNL). A flight line spacing of 37 meters (120 feet) and a survey altitude of 46 meters (150 feet) yielded the maximum data density and sensitivity achievable by the aerial system, which was greater than that achieved from prior surveys of the entire Oak Ridge Reservation. Isopleth maps of Cs-137, Co-60, Ti-208 implied concentrations, and exposure rates provided an estimate of the location and magnitude of the man-made activity. These maps, overlaid on a current photograph of the area, combine to yield a view of the radiological condition of the White Oak Creek Floodplain. 5 refs., 40 figs., 3 tabs.

45152 **(PB—87-207437/XAB) Final rule for radon-222 emissions from licensed uranium mill tailings - economic analysis. Final report.** (Office of Radiation Programs, Washington, DC (USA)). Aug 1986. 239p. (EPA—520/1-86/010). NTIS, PC A11/MF A01.

The report presents the findings of an economic analysis of alternative proposed work practices for controlling radon-222 emissions during the operation of licensed uranium mills. It gives descriptions of proposed alternative work practices for controlling radon-222 emissions from tailings impoundments and estimates of

the benefits and costs of these alternative work practices. It also discusses the probable economic imports of the proposed rules and consideration of the financial impacts of the proposed rule on the owners of existing and future mills, and the consumers of nuclear generated electricity.

0540 Health And Safety

REFER ALSO TO CITATION(S) 45512, 46186, 46200, 46298

45153 (ANL—87-8) Site surveillance and maintenance program for Palos Park: Report for 1986. Golchert, N.W. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008603.

The results of the environmental monitoring program conducted at Site A/Plot M in the Palos Park Forest Preserve area for CY 1986 are presented. The monitoring program reflects remedial action subsequent to the original radiological characterization of the site. The program consists of sample collection and analysis of air, surface and subsurface water, and bottom sediment to determine the migration pathway of water from the burial ground (Plot M) to hand-operated picnic wells, establish if buried radionuclides other than hydrogen-3 have migrated, and generally characterize the radiological environment of the area. New studies include the migration of non-radiological hazardous waste constituents that may have been buried with the radioactive waste, based on an analysis of borehole water samples for selected heavy metals and organic compounds. Hydrogen-3 in the Red Gate Woods picnic well continued to show the same pattern of elevated levels in the winter and low concentrations in the summer, but the magnitude of the winter peak was significantly less than in earlier years. Recent measurements indicate the presence of strontium-90 in borehole water next to Plot M. The program established that the radioactivity remaining at Site A/Plot M does not endanger the health or safety of the public visiting the site of those living in the vicinity. 14 refs., 6 figs., 14 tabs.

45154 (INIS-mf—10939) Radiation protection 1/87. Holeczke, F.; Kaercher, K.H.; Kainberger, F.; Mader, H.; Seyss, R. (eds.). (Verband fuer Medizinischen Strahlenschutz in Oesterreich, Vienna). 1987. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703106.

There is a paper on medical first aid after radiation accidents and another on positive effects of low-dose irradiation which are treated separately. In addition there are four contributions on question of conventional X-ray diagnosis. (G.Q.).

45155 (SAAS—344, pp 3-7) Type testing of gamma radiography devices in the GDR. Eisenreich, M. 1986. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780163. (CONF-8509389—Pt.4).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

Based on long-term experience in applying gamma radiography devices in the GDR, mainly the GAMMAMAT type, and on the experience gained in type testing the Czechoslovakian device MIRID, principal safety criteria for portable gamma radiography devices are compiled and briefly discussed.

45156 (SAAS—344, pp 15-24) Performance of a written radiation protection inspection of nonstationary gamma radiography users. Hoehne, M. 1986. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780163. (CONF-8509389—Pt.4).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

A questionare has been developed for controlling users of nonstationary gamma radiography devices. It is aimed at obtaining information about the weak points according to radiation protection and to give guidance in performing such controls by the respective radiation protection officers. The questionare is included.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 45084, 45556, 45874, 45875, 46682

45157 (BNL—40059) The NINO [No Inspector, No Operator system] cask-loading safeguards system. Fiarman, S. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870713—49). NTIS, PC A02. File Number DE87013309.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

It is, in general difficult to determine by means of camera-surveillance techniques what is loaded into spent-fuel casks being prepared for shipment from light-water reactors to other reactors, reprocessing facilities, or long-term storage. Furthermore, the expected high frequency of cask loadings in the coming years would place too great a burden on the IAEA and Euratom inspectorates if each had to be observed by an inspector. For the case of shipment to other reactors and reprocessing facilities, the casks are soon opened and, in principle, their contents could be ascertained by direct inspection. In the case of long-term-storage facilities, the casks would stay sealed for years, thereby requiring the IAEA to know positively how many spent-fuel assemblies were loaded at the reactor and to have a continuity of knowledge of the cask's contents. It has been proposed instead that the facility operator place the cask seal on the cask within the field of view of a surveillance system linked to the cask seal. This solution, however, may not provide enough credibility for acceptance by the safeguards community. This paper presents an alternative to both inspector presence at cask loading and operator assistance in applying seals; this alternative is called the No Inspector, No Operator system (NINO).

45158 (BNL—40063) What are the attributes of a good standard and associated criteria?. Allentuck, J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870713—56). NTIS, PC A02. File Number DE87014289.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The Department of Energy (DOE) Standards and Criteria (S & C) provide the framework upon which Office of Security Evaluations (OSE) inspections of safeguards and security at DOE facilities are conducted. The S & C were created to assure that inspections are comprehensive, standardized to the extent possible and accurately reported in meaningful terms, and that assessments are objective. With these goals in mind, the desirable attributes of a standard and its associated criteria are relevance, inspectability, and limited need for inspector judgement. 1 fig.

45159 (BNL—40118) A general approach to error propagation. Sanborn, J.B. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870713—55). NTIS, PC A02. File Number DE87014287.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A computational approach to error propagation is explained. It is shown that the application of the first-order Taylor theory to a fairly general expression representing an inventory or inventory-difference quantity leads naturally to a data structure that is useful for structuring error-propagation calculations. This data structure incorporates six types of data entities: (1) the objects in the material balance, (2) numerical parameters that describe these objects, (3) groups or sets of objects, (4) the terms which make up the material-balance equation, (5) the errors or sources of variance and (6) the functions or subroutines that represent Taylor partial derivatives. A simple algorithm based on this data structure can be defined using formulas that are sums of squares of sums. The data structures and algorithms described above have been implemented as computer software in FORTRAN for IBM PC-type machines. A free-form data-entry format allows users to separate data as they wish into separate files and enter data using a text editor. The program has been applied to the computation of limits of error for inventory differences (LEIDs) within the DOE complex. 1 ref., 3 figs.

45160 **(HEDL-SA—3498-FP) Quality assurance for packaging of radioactive and hazardous materials.** Gustafson, L.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 1986. Contract AC06-76FF02170. 7p. (CONF-860654—49). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014363.

From 27. annual meeting of the Institute of Nuclear Materials Management; New Orleans, LA, USA (22 Jun 1986).

The Department of Energy (DOE) has required for many years that quality assurance programs be established and implemented for the packaging of radioactive and hazardous materials. This paper identifies various requirement principles and related actions involved in establishing effective quality assurance for packaging of radioactive and hazardous materials. A primary purpose of these quality assurance program activities is to provide assurance that the packaging and transportation of hazardous materials, which includes radioactive and fissile materials, are in conformance with appropriate governmental regulations. Applicable regulations include those issued by the Nuclear Regulatory Commission (NRC), the Department of Transportation (DOT), and the Environmental Protection Agency (EPA). DOE Order 5700.6A establishes that quality assurance requirements are to be applied in accordance with national consensus standards where suitable ones are available. In the nuclear area, ANSI/ASME NQA-1 is the preferred standard. Applicable Federal Regulations include: Nuclear Regulatory Commission Regulations - Primarily 10 CFR Part 71, "Packaging of Radioactive Material for Transport, and Transportation of Radioactive Material Under Certain Conditions." Department of Transportation Regulations - Primarily 49 CFR Parts 171-199, "Hazardous Materials Regulations." Environmental Protection Agency - Primarily 40 CFR, designating regulated types of hazardous materials.

45161 **(KFK—4216) PROSA: A computer program for statistical analysis of near-real-time-accountancy (NRTA) data.** Beedgen, R.; Bicking, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Apr 1987. 43p. (PWA—8/87). NTIS, PC E07; Available from NTIS as TIB/B87-10662.

The computer program PROSA (Program for Statistical Analysis of NRTA Data) is a tool to decide on the basis of statistical considerations if, in a given sequence of materials balance periods, a loss of material might have occurred or not. The evaluation of the material balance data is based on statistical test procedures. In PROSA three truncated sequential tests are applied to a sequence of material balances. The manual describes the statistical background of PROSA and how to use the computer program on an IBM-PC with DOS 3.1.

45162 **(LA-UR—87-2242) Variance and covariance calculations for nuclear materials accounting using "MAVARIC".** Nasseri, K.K. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 6p. (CONF-870713—50). NTIS, PC A02. File Number DE87013134.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Determination of the detection sensitivity of a materials accounting system to the loss of special nuclear material (SNM) requires (1) obtaining a relation for the variance of the materials balance by propagation of the instrument errors for the measured quantities that appear in the materials balance equation and (2) substituting measured values and their error standard deviations into this relation and calculating the variance of the materials balance. MAVARIC (Materials Accounting VARIance Calculations) is a custom spreadsheet, designed using the second release of Lotus 1-2-3, that significantly reduces the effort required to make the necessary variance (and covariance) calculations needed to determine the detection sensitivity of a materials accounting system. Predefined macros within the spreadsheet allow the user to carry out long, tedious procedures with only a few keystrokes. MAVARIC requires that the user enter the following data into one of four data tables, depending on the type of the term in the materials balance equation; the SNM concentration, the bulk mass (or solution volume), the measurement error standard deviations, and the number of measurements made during an accounting period. The user can also specify if there are correlations between transfer terms. Based on these data entries, MAVARIC can calculate the variance of the materials balance and the square root of this variance, from which the detection sensitivity of the accounting system can be determined.

45163 **(LA-UR—87-2243) A simulation model for material accounting systems.** Coulter, C.A.; Thomas, K.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-870713—52). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013135.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A general-purpose model that was developed to simulate the operation of a chemical processing facility for nuclear materials has been extended to describe material measurement and accounting procedures as well. The model now provides descriptors for material balance areas, a large class of measurement instrument types and their associated measurement errors for various classes of materials, the measurement instruments themselves with their individual calibration schedules, and material balance closures. Delayed receipt of measurement results (as for off-line analytical chemistry assay), with interim use of a provisional measurement value, can be accurately represented. The simulation model can be used to estimate inventory difference variances for processing areas that do not operate at steady state, to evaluate the timeliness of measurement information, to determine process impacts of measurement requirements, and to evaluate the effectiveness of diversion-detection algorithms. Such information is usually difficult to obtain by other means. Use of the measurement simulation model is illustrated by applying it to estimate inventory difference variances for two material balance area structures of a fictitious nuclear material processing line.

45164 **(NUREG—0430-Vol.7-No.2) Licensed fuel facility status report: Inventory difference data, July 1986-December 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Aug 1987. 15p. NTIS, PC A02/MF A01 - GPO. File Number TI87900968.

NRC is committed to the periodic publication of licensed fuel facilities' inventory difference data, following agency review of the information and completion of any related investigations. Information in this report includes inventory difference data for active fuel fabrication facilities possessing more than one effective kilogram of high enriched uranium, low enriched uranium, plutonium, or uranium-233.

45165 **(NUREG—0525-Rev.13) Safeguards Summary Event List (SSEL): Pre-NRC through December 31, 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards and Transportation). Jul 1987. 86p. NTIS, PC A05/MF A01 - GPO. File Number TI87900930.

The Safeguards Summary Event List (SSEL) provides brief summaries of several hundred safeguards-related events involving nuclear material or facilities regulated by the US Nuclear Regulatory Commission (NRC). Events are described under the categories of bomb-related, intrusion, missing and/or allegedly stolen, transportation, tampering/vandalism, arson, firearms, radiological sabotage, nonradiological sabotage and miscellaneous. The information contained in the event descriptions is derived primarily from official NRC reporting channels.

45166 **(SAND—87-0835C) An object oriented real time knowledge based system.** Davidson, C.S.; Moseley, M.R. (Applied Methods, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 25p. (CONF-871046—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87007341.

From Conference on object-oriented systems, languages and applications (OOPSLA); Kissimmee, FL, USA (4 Oct 1987).

Our software generator produces code specific to the needs of a site according to the security system specification entered. System specific code is then combined with invariant runtime modules to create software which controls alarm processing and display system(s). The variability of configurations we must support sug-

gested using an object oriented design for the invariant runtime modules and a knowledge base to control the system level interactions. We implemented an object oriented design in a language which did not support many standard OOP features such as dynamic binding and met our worst case realtime requirements by processing 1200+ rules/minute.

45167 **(SAND—87-1354C) Strong practical protocols.** Moore, J.H. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870833—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014215.

From Crypto '87; Santa Barbara, CA, USA (16 Aug 1987).

Research in the area of cryptographic protocols has been considering methods to provide "provably secure" protocols. Progress has been made, although the initial results either apply to systems which have been idealized in order to simplify the problem or use techniques to gain security which are not practical for application. These techniques are obtained using abstract principles designed to model ideal security systems. However, when cryptosystems are actually fielded, much less abstract principles are applied. Rather than trying to model ideal systems to provide "provably secure" protocols, we propose the development of techniques for use by protocol designers to precisely define the security provided by the protocol.

45168 **(UCRL—96932) Tactical Vulnerability Assessment Training Program.** Al-Ayat, R.A.; Judd, B.R.; Renis, T.A.; Paulus, W.K.; Winblad, A.E.; Graves, B.R. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Livermore, CA (USA); USDOE Central Training Academy, Albuquerque, NM). 10 Jul 1987. Contract W-7405-ENG-48. 7p. (CONF-870713—46). NTIS, PC A02. File Number DE87013485.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The Department of Energy sponsors a 9-day training program for individual who are responsible for evaluating and planning safeguards systems and for preparing DOE Master and Security Agreements (MSSAs). These agreements between DOE headquarters and operations offices establish required levels of protection. The curriculum includes: (1) the nature of potential insider and outsider threats involving theft or diversion of special nuclear material, (2) use of computerized tools for evaluating the effectiveness of physical protection and material control and acoountability systems, and (3) methods for analyzing the benefits and costs of safeguards improvements and for setting priorities among proposed upgrades. The training program is varied and highly interactive. Presentations are intermixed with class discussions and "hands-on" analysis using computer tools. At the end of the program, participants demonstrate what they have learned in a two-and-one-half day "field excercise," which is conducted on a facility scale-model. The training programs has been conducted six times and has been attended by representatives of all DOE facilities. Additional sessions are planned at four-month intervals. This paper describes the training program, use of the tools in preparing MSSAs for various DOE sites, and recent extensions and refinements of the evaluation tools.

45169 **The role of systems studies in safeguards: Designing integrated systems.** Tape, J.W.; Coulter, C.A.; Markin, J.T. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 79-82(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

Systems studies play an important role in the design of integrated systems to meet the requirements of a changing safeguards environment. The traditional organization of safeguards activities into physical protection, materials control, and materials accounting functions inhibits integration. One may facilitate integration and provide effective protection from the insider threat by reorganizing these activities into authorization, enforcement, and verification functions, and by emphasizing management of information.

45170 **Low level detection in safeguards and verification.** Dowdy, E.J. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 93-96(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

The Advanced Nuclear Technology Group of the Los Alamos National Laboratory comprises the original verification and surveillance safeguards group formed a few years after the establishment of the safeguards program at the Laboratory, vestiges of several other groups that had been involved in developing methods for low level detection.

45171 **1987 target values for uncertainty components in fissile isotope and element assay.** De Bievre, P.; Baumann, S.; Gorgenyi, T.; Kuhn, E.; Deron, S.; Dalton, J.; Perrin, R.E.; Pietri, C.; De Regge, P. (Central Bureau for Nuclear Measurements, Joint Research Centre, Geel Establishment, Commission of the European Communities, Geel). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 99-104(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

The Working Group on Techniques and Standards for Destructive Analysis (WGDA) of the European Safeguards Research and Development Association (ESARDA), which at present includes the representation of 37 nuclear analytical laboratories, has long been concerned with defining realistic performance characteristics of destructive analysis techniques. One of the terms of reference of the working groups is: "to evaluate and recommend criteria for destructive analysis of nuclear materials for use by plant operators and safeguarding authorities". Some of the most important and most badly needed criteria are those to be used for judging results of quantitative determinations of fissile isotope and element amounts. The working group has recognized and discussed this problem at several meetings and decided that it was appropriate to fix reasonable levels of performance as "goals" for nuclear analytical laboratories.

45172 **Safeguards at Los Alamos: 20 years.** Hecker, S. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 22(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

In addition to this Laboratory's responsibilities in the areas of national defense, energy, and basic research, verification of arms control measures, and international security are receiving attention. The safeguards developments at Los Alamos are described. The worldwide system of safeguards and international cooperation could serve as a guide for cooperation in verification of arms control agreements.

45173 **The US DOE safeguards program.** Hammond, G.A. (U.S. Dept. of Energy, Office of Safeguards and Security, Washington, DC). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 37-38(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

By 1977, NDA techniques were becoming widely used. The first semi-annual report on inventory differences (This one covering 20 years) was published. Safeguards were an important subject in President Carter's study of alternative nuclear fuel cycles. Since then increasing emphasis has been placed on defining the threats (theft or sabotage) and on coordinating the R and D, the surveys and reviews, and on providing technical assistance to the DOE facilities and to the IAEA. A Central Training Academy was established in 1985 for security personnel. The future R and D directions are summarized.

45174 **The evolution of safeguards since Trinity - One man's viewpoint.** Higinbotham, W.A. (Brookhaven National Lab., Upton, NY). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 39-42(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

This article discusses the Acheson-Lilienthal Report, The Baruch Proposal, The Toms for Peace conference in 1955, IAEA inspections of U.S. nuclear facilities in 1964-68, and the Lumb Panel Report of 1967 which led to the establishment of safeguards offices by the Atomic Energy Commission. The Atomic Energy Commission was split into the Nuclear Regulatory Commission and the Energy Research and Development Authority in 1974. The latter became the Department of Energy in 1977. The role of these and other government agencies in domestic and international safeguards is explained. The development of international safeguards for centrifuge enrichment plants is outlined.

45175 **Safeguards R and D at Los Alamos: The first 20 years.** Keepin, G.R. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 43-49(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

The author became interested in safeguards as an employee of the International Atomic Energy Agency (IAEA) in 1963-65. With the support of the director of Los Alamos and of the Atomic Energy Commission, the Los Alamos safeguards group was established. From the start, this group worked closely with the nuclear processing groups there. Some of the improtant contributions of the group are illustrated: the mobile NDA laboratory, DYMAC, several instruments in use by the IAEA. The group provides technical assistance to private and government facilities in the U.S. and works with development groups in other countries on behalf of the IAEA. The several training courses conducted by Los Alamos for U.S. private and government employees, IAEA inspectors, and personnel from developing countries are described.

45176 **Safeguards R and D at Los Alamos: The next 20 years.** Shipley, J.P. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 50-52(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

The new facilities here and abroad will present new problems while new technology will present new opportunities. We must learn what the goals and objectives mean and how to satisfy the customers. Recent steps by the Los Alamos Laboratory to meet the challenge are summarized as follows: general principles: Safeguards should be integral part of facility operations. Safeguards should be transparent so that the effectiveness is evident. Safeguards goals: Maximize effectiveness, minimize intrusiveness, impact on production, and costs. To be satisfied: Those engaged in safeguards; those who are safeguarded; those dependent on safeguards, the public, and; potential adversaries to be deterred.

45177 **History of physical security R and D.** Myre, W.C.; De Montmollin, J.M. (Sandia National Labs., Albuquerque, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 61-63(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

Serious concern about physical protection of nuclear facilities began around 1972. R and D was initiated at Sandia National Laboratory which had developed techniques to protect weapons for many years. Special vehicles, convoy procedures, and a communications system previously developed for weapons shipments were improved and extended for shipments of other sensitive materials. Barriers, perimeter alarms, portal and internal control systems were developed, tested, and published in handbooks and presented at symposia. Training programs were initiated for U.S. and foreign personnel. Containment and surveillance techniques were developed for the IAEA. Presently emphasis is on computer security, active barriers, and techniques to prevent theft or sabotage by "insiders".

45178 **Safeguards from the operators viewpoint.** Christensen, E.L. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 64-67(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

Since its inception as a nuclear materials processing facility, nuclear materials accounting has been an integral part of process operations at Los Alamos. Accountability practices have been improved from largely destructive assay in 1950 to resolve inventory differences to heavy reliance on NDA today. Much of the NDA development at the plutonium processing facility has been made possible by a close physical and working relationship with the safeguards research and development personnel.

45179 **Safeguards: The past present, and future.** Seaton, M.B. (U.S. Dept. of Energy, Washington, DC). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 68-70(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

The non-destructive assay techniques developed at Los Alamos have become a primary means for verification by the IAEA and most important for domestic safeguards. We must challenge our assumptions, e.g., that inventory differences are a valid measure of safeguards performance, that more money is the solution, and the threats are much exaggerated. A human reliability program will be initiated. Material control, accounting, and physical protection need further integration. A serious effort involving scholarships, internships, etc. is needed to attract and motivate young people. Increased emphasis will be placed on designing safeguards into new systems such as laser isotope separation. Finally, continuing generous support for the IAEA is most important.

45180 **DYMAC - The first stab at large safeguards systems.** Augustson, R.H. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 71-74(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

This article discussed the evolution of the Los Alamos Safeguards Program that led to the concept of dynamic materials accountability and control (DYMAC). A plant specific DYMAC system was installed at the Los Alamos Plutonium Facility, TA-55, in 1978. This system was turned over to the plant management and is still operational today. Systems like DYMAC/TA-55 provide necessary and realistic data on the workability of near-real-time accountability in nuclear material processing facilities.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 45148

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

REFER ALSO TO CITATION(S) 46058

0701 Physical Isotope Separation

45181 **Transverse and dispersion effects in the simultaneous propagation of short different-wavelength pulses in three-level absorbers.** Mattar, F.P.; Matos, A.W.; Richard, A.; De Lettrez, J.; Babuel-Peyrissac, J.P.; Marinier, J.P.; Bardin, C. (Dept. of Physics, New York Univ., New York, NY 10003). pp 1387-1544 of Modeling and simulation. Hanham, R.; Vogt, W.G.; Mickle, M.H. Pittsburgh, PA; University of Pittsburgh (1986). (CONF-8604298—).

From 17. annual Pittsburgh conference on modeling and simulation; Pittsburgh, PA, USA (24 Apr 1986).

A comprehensive effort is being carried out to study the phenomena associated with the co-propagation of two different-wavelength optical pulses in a nonlinear homogeneously broadened

three-level atomic system which can sustain amplification or absorption. This is a double self-induced-transparency. The atomic configuration can be cascade, lambda or vee. The beams strongly influence each other by exchanging energy back and forth with the resonant medium. The semi-classical formalism is adopted as well as the slowly-varying-envelope approximation. The principal motivation is reaching an understanding of this fundamental double resonance interaction and elucidating the temporal synchronization and the single-photon distortion free co-propagation for each beam in Double Self-Induced-Transparency SIT, Two-color super-fluorescence and coherent pump depletion effects on (a) Stokes and (b) Super-fluorescence buildup. Extension of this current research to multi-level systems would be relevant to laser chemistry and laser isotope separation.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 45714, 46258

45182 **(OEFZS—4393) Radiation curing. Comparison of heat, UV and radiation curing.** Wendrinsky, J. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Apr 1987. 47p. (CH—371/87). NTIS (US Sales Only), PC A03/MF A01. File Number DE87703126.

In the beginning of the seventies the two types of radiation sources applied in industrial processes, electron radiation and UV, had been given rather optimistic forecasts. While UV could succeed in the field of panel and film coating, electron radiation curing seems to gain success in quite new fields of manufacturing. The listing of the suggested applications of radiation curing and a comparison of both advantages and disadvantages of this technology are followed by a number of case studies emphasizing the features of these processes and giving some examplary calculations. The data used for the calculations should provide an easy calculation of individual manufacturing costs if special production parameters, investment or energy costs are employed.

45183 (PEL—287, pp 60E-70) **Industrial application of radioisotopes in South Africa: a bibliographic review.** De Jesus, A.S.M.; Smith, S.W.; Van As, D.; De Wet, W.J.; Du Plessis, T.A. (Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria; Iso-Ster, Pty. Ltd., Kempton Park, South Africa). Dec 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87703127.

This bibliographic review consists of an introduction and four categories on this subject field, each with its own bibliography.

In Radioactive isotopes and radiation in South Africa: a bibliographic review.

Since 1963 considerable strides have been made concerning the application of nuclear radiation, in most cases provided by radioisotopic sources, in the South African industry. South Africa has moved from a phase where the emphasis was on experimenting and learning to a phase where the technologies developed over the years are being put to work in a productive manner by exploiting them, largely complementary to other non-nuclear technologies. Classification in terms of application areas includes subjects such as process control, elemental analysis, industrial processes, mining exploration and prospecting, environmental applications and radiation processing.

45184 (ZfI-Mitt—122, pp 125-148) **Influence of the vertical density profile on the detectable scattering quantum number in very simplified forward and backward scattering models for quantum radiation. 1. Calculation of mean values.** Braune, M. Nov 1986. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

The dependence between the radiometric counting results and the vertical density profile of bulk material is described using extremely simplified mathematical models for X radiation forward- and backscattering. The mean values of the radiometric counting results are calculated, if the thickness and the vertical density profile of the bulk material are independent, normal distributed stochastic variables with time independent mean values and standard deviations.

0703 Isotopic Power Supplies

45185 **(ESA-CR(P)—2310) Radioisotope generators for space probes. Final report.** Myatt, J. (UKAEA Atomic Energy Research Establishment, Harwell). Oct 1985. 117p. (ETN—87-99865). NTIS, PC A06/MF A01.

The feasibility of setting up the production of small radioisotope power sources (250 W(e)) in Europe for use in the ESA space program was assessed. It is concluded that it is necessary to use a radioisotope fuelled generator with a thermoelectric convertor at the power level under consideration. Although development of individual components is needed, there is the capability to mount such a program in Europe. Cost estimates for a plutonium 238 generator are provided.

0704 Economics

REFER ALSO TO CITATION(S) 46260

08 HYDROGEN

REFER ALSO TO CITATION(S) 45227

0801 Production

45186 **(BNL—39736) Clean carbon and hydrogen fuels from coal and other carbonaceous raw materials.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 10p. (CONF-871030—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012111.

From Coal science international conference; Maastricht, Netherlands (26 Oct 1987).

A new approach is presented which produces a clean particulate carbon fuel and a gaseous hydrogen-rich fuel from coal or other carbonaceous raw materials. The process consists of deep hydrogenation of the carbon containing raw material for the production mainly of gaseous methane. The methane is subsequently thermally cracked to micron-sized carbon black particulates and hydrogen gas. The excess hydrogen is recycled. The mineral (ash) impurities remain condensed and are separated. Oxygen impurity is removed as water, sulfur is removed as a solid or gaseous sulfide, and nitrogen is removed as a purge gas. The process is highly mass and energy efficient. The process essentially distills carbon out of the raw material, and depending on the hydrogen/oxygen (H/O) stoichiometry, also produces a hydrogen-rich gaseous by-product fuel stream. The clean particulate carbon can be made fluid by slurrying with water, methanol, or petroleum distillates. The carbon can be used in conventional combustors and the carbon-oil-mixes (COM) in heat engines (turbines and diesels), however, the carbon-water-mixes (CWM) require igniters to make up for the lack of volatility of the carbon. The clean carbon fuel appears to be economically competitive with current (1987) costs of conventional petroleum distillates and is thus a means of converting coal, natural gas, wood, char, resids, and waste materials, e.g., tires and municipal solid waste (MSW), into competitive and environmentally acceptable fuels. 6 refs., 1 fig., 1 tab.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 45238, 45709

45187 **(DOE/PC/80015—7) Fischer-Tropsch slurry phase process variations: Quarterly report for period April 1, 1987 to June 30, 1987.** Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract AC22-85PC80015. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013807.

Our studies of the effects of adding various selected olefins during Fischer-Tropsch synthesis have now been summarized in the form of a paper for publication. The principal observations and conclusions are: In studies with a reduced fused magnetite catalyst at 248°C, and 0.78 to 1.48 MPa, reactions of the added species were much more significant at high synthesis conversions where the relatively lower partial pressure of CO allowed competitive adsorption effects with CO to become more important. Ethanol decreased hydrogenation capabilities of the catalyst as reflected in lower CH_4 formation and higher olefin-paraffin ratio. Excluding ethylene, which is unusually reactive, the reactivity of an 1-olefin increased with molecular weight, but almost exclusively to form the corresponding paraffin or β-olefin. Incorporation of olefins into growing chains was relatively small.

45188 **(ETSU-B—1043) Generation of gases from biomass by anaerobic digestion and their practical utilization as fuel.** Plaskett, L.G. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1984. 93p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The potential for production of biogas economically from manure, plants and plant residues is studied in order to establish the cost and circumstances that will apply to their effective utilization and to identify any technical barriers which must first be overcome. The nature and availability of feedstocks, the utilization of digester residues, the demand of biogas, and process costing are discussed.

45189 **(ETSU-B—1051/5) Experimental studies on catch fuel crops. Annex 4: catch crop utilization.** Carruthers, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Jan 1984. 63p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Biofuels Research and Development Programme.

The technology of anaerobic digestion is reviewed in relation to feedstocks provided by growing catch crops for fuel. Feedstock characteristics, transport and processing, digestion efficiency, products of anaerobic digestion, and biogas and residue utilization are discussed. Other processes including drying and burning, aerobic decomposition, hydrolysis and yeast fermentation, and bacterial fermentation are considered.

45190 **(IFU-B—05/86) Comparative testing and evaluation of biomass conversion plants. Final report.** Padinger, R.; Brunner, N.; Karrer, M.; Panholzer, M.; Scheucher, P.; Spitzer, J. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Aug 1986. 350p. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung.

Fundamental laboratory research into the anaerobic digestion of different substrates as well as the testing of 6 biomass conversion plants over a period of several years resulted in recommendations concerning the optimal selection of design and operation parameters for agricultural biomass conversion plants. Based on the experimental results obtained mathematical models were used to plot characteristic curves for agricultural biomass conversion plants. The curves allow to assess the respective optimal design and operation parameters. With 149 figs., 48 tabs.

45191 **(IFU-B—14-86) Agricultural uses of biogas - latest trends and prospects. Overall report on the results of Austrian biogas research 1980-1985.** Padinger, R. (ed.). (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). 1986. 444p. (In German). (CONF-8604352—Summs.). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung.

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The report summarizes the papers presented on the occasion of the meeting on 'agricultural uses of biogas' which took place on April 16, 1986 in Vienna. The selection of papers allows an overall survey of the relevant research results. Moreover, the report briefly informs about the results of about 22 subprojects of the research program. 18 papers have been abstracted separately.

45192 (IFU-B—14-86, pp 26-30) **'Spitzer' biomass conversion plant.** Plank, J. (Landeskammer fuer Land- und Forstwirtschaft in Steiermark, Graz, Austria). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

Experiments and tests have proved the suitability of the basic design of the plant, as well as the feasibility of a low-capacity eccentric spiral pump charging the plant with mansures which have been homogenized in a processing pit and can easily be discharged into a storage pit. However, only a 100 per cent all-the-year-round and on-the-spot utilization of the gases produced will make the plant an economic solution.

45193 (IFU-B—14-86, pp 73-120) **Biomass conversion pilot plant of the Federal Institute for Agricultural Technology, Wieselburg.** Lampel, H. (Bundesanstalt fuer Landtechnik, Wieselburg, Austria). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

Among the research and testing activities of the Federal Institute for Agricultural Technology, Wieselburg, was the construction of a biomass conversion plant equipped with a cylindrical steel digestion tank with a gross volume of 10 m/sup 3/ and a capacity of 8 m/sup 3/. The biogas technology team reported its efforts to have succeeded in reducing the digestion tank capacity for certain substrates, in facilitating the operation of the system, improving its operational reliability and roughly adapting the gas production to gas consumption. An optimal communication of substrates, well-dosed and controlled feeding of substrates, special conduction of substrates inside the digestion tank as well as microprocessor control systems accounted for the results obtained. The tests were based on the following variable parameters: - digestion tank temperatures 36/sup 0/C, 32/sup 0/C and 28/sup 0/C - retention time 20, 16, 13, 10 and 8 days - inoculum recirculation rate 0%, 2.5%, 5% and 10%. In all cases substrates consisted in cattle manures containing little straw which were supplied by a bull fattening farm.

45194 (IFU-B—14-86, pp 121-130) **Technology and economy of different biogas uses.** Pernkopf, J. (Bundesanstalt fuer Landtechnik, Wieselburg, Austria). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The paper shows that at present small-scale biomass conversion plants disposing of less than 30 GVE (1 GVE = cattle, 500 kg live weight) do fail to operate in an efficient and economic way. However, small-scale biogas production is expected to be profitable as soon as developmental efforts succeed in considerably reducing the first cost and increasing the working life of the respective plants. Much as larger-scale plants are better off in many respects economy does not simply fall to them. One of the prior conditions contributing to a successful economic biogas production consists in a continuous and complete utilization of the gases. It is equally important for the utilization of gases to involve but a minimum of additional investments. By way of discussing the examples of electric power generation and tractors the paper makes evident that excessive additional investments can be weighing as heavily on biomass conversion as to make it unprofitable.

45195 (IFU-B—14-86, pp 131-137) **Eternit biomass conversion plant.** Schuetz, P. (Bundesministerium fuer Wissenschaft und Forschung, Vienna, Austria). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The biomass conversion plant described essentially consists of Eternit asbestos cement components. Its bioreactor is equipped with a coiled heat exchanger. The subdivision of the digestion chamber into an upper and lower fermentation duct contributes to a

positive retention profile in spite of the intimate mixing of fresh substrates and digestion sludges. The biomass conversion plant is suited for 20-50 GVE farms (1 GVE = cattle, 500 kg live weight).

45196 (IFU-B—14-86, pp 139-145) **Edelhof MET-OEMV biomass conversion plant.** Ploder, W.; Harhammer, S. (Oesterreichische Mineraloelverwaltung A.G., Schwechat. Raffinerie Schwechat). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The biomass conversion plant described was designed for the processing of the manures of 20 GVE (1 GVE = cattle, 500 kg live weight). It is periodically fed from out of a liquid manure basin above the digestion chamber. The manures are digested at about 32/sup 0/C. The retention period is 25 days. The completely digested manures are drawn off by means of a special-purpose pump for thick matters at the very bottom of the bioreactor. The biogas produced passes a safety system combining the functions of a pressure control value, condensate separator and pressure keeper. For different energy uses it is then fed to a cogeneration system designed by the Ford company. Compared with thermal processing procedures (combustion) a both mechanical and thermal utilization of biogas energy potentials results in a better and more practical use of the gases for electric power and water heating purposes.

45197 (IFU-B—14-86, pp 153-173) **Heat recovery and heating systems optimization in biomass conversion plants.** Schuetz, P. (Bundesministerium fuer Wissenschaft und Forschung, Vienna, Austria). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

Experiences gained in the operation of small-scale agricultural biomass conversion plants show that their heat demand has an essential influence on their economic operation. Due to the fact that there are bioreactors whose energy demand is as high as to make them unsuited and unprofitable for energy uses the paper gives access to a number of suggestions concerning the convenient optimization of biomass conversion plants. The measures pointed out comprise waste heat recovery methods and high-efficiency heating systems.

45198 (IFU-B—14-86, pp 175-187) **Applied microbiology and biogas technology.** Braun, R. (Universitaet fuer Bodenkultur, Vienna, Austria. Inst. fuer Angewandte Mikrobiologie). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

At the present state of knowledge on mixed cultures, applied microbiology can only be an indirect help to owners of biogas plants, e.g. in the fields of substrate analysis, assessment of digestion properties, and detection of potential inhibitory effects. Three years of measurements and investigations have clearly shown that the solution of technical problems as well as economic considerations should have priority in practice.

45199 (IFU-B—14-86, pp 189-211) **Simple analyses for biomass conversion plants.** Panholzer, M. (Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The paper describes the selection of ergonomic, laboratory-tested analysis equipment. Together with laboratory checks the biomass conversion performance tests determined the configuration of a practical set of instruments: one ifu-CH/sub 4/ measuring instrument determining the methane content of biogases, one Deutsch and Puchwein liquid manure hydrometer determining the dry substances contained in fresh liquid manures as well as pH-indicators (Neutralit by Merck) measuring the pH-value of the digested manures. Along with instructions the instruments described are a convenient diagnostic vehicle in the case of disturbances or breakdowns and during the initiation of systems and allow for immediate measures restoring the stable working order of the biomass conversion plant.

45200 (IFU-B—14-86, pp 229-288) **Methane digestion laboratory tests in different media.** Panholzer, M. (Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

Laboratory-scale digestion tests determined the specific gas yields and gas formation rates typical of substrates such as swine-manures, cattle manures with or without straw, manures of horses and fowl after specified retention periods. By varying the substrate/incolum (decomposing substances) ratio it is possible to determine the inoculation degree required for unchecked digestion processes. Proof has been given of the fact that as soon as the substrate and inoculum do reach their specific minimum inoculation degree additional inoculum will not increase the specific gas yield. Analyses have shown that digestion in a batch digestion test is equal to the volumes element digestion processes in biomass conversion plants. It is but under these conditions that laboratory results can be referred to during biomass conversion plant calculations. Due to the fact that temperatures are one of the essential operational biomass conversion parameters analyses included the assessment of the effects of digestion temperatures on the specific gas yield of selected substrates. A mathematical model served to generalize the results. Mixed substrate digestion tests did not show any mutural effects. The total gas yield of biomass conversion plants can therefore generally be assumed to be the product of the total yields of the individual components involved.

45201 (IFU-B—14-86, pp 289-383) **Performance of different types of biogas plants.** Padinger, R. (Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

To choose the optimum design and performance parameters of agricultural biogas plants, the performance of these plants in different operating conditions must be investigated very thoroughly. For this purpose, performance measurements were carried out on six different types of biogas plants and with different substrates. The measurements, together with the results of batch digestion experiments with substrates taken from the biogas plants, were used for establishing mathematical models of the digestion process and of the plant performance. Further model calculations were made in order to determine product gas yields with different parameter variations, and performance characteristics were established for biogas plants with different flow conditions in the digester. The optimum design and operating parameters are derived from these data.

45202 (IFU-B—14-86, pp 385-389) **Prospects of biomass conversion in the Federal Republic of Germany.** Baader, W. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig, Germany, F.R. Inst. fuer Technologie). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The paper gives a general survey of the developmental state of biomass conversion plants in the Federal Republic of Germany. At minimum bioreactor contents a controlled processing is considered to provide for high digestion rates or methane yields, respectively. Reactor and agitator designs ought to depend on the types of substrates.

45203 (IFU-B—14-86, pp 391-400) **Prospects and perspectives of biomass conversion in Switzerland.** Wellinger, A.; Egger, K. (Eidgenoessische Forschungsanstalt fuer Betriebswirtschaft und Landtechnik, Taenikon, Switzerland). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

Although in comparison with 1979-1983 the development of biomass conversion in Switzerland has meanwhile been slipping back into a slower pace the technology has been making its way and standing the test in the domain of agriculture. The report abstracted briefly describes the major types of biomass conversion plants and discusses the latest trends observed.

45204 (IFU-B—14-86, pp 401-402) **Importance of agricultural biomass conversion.** Spitzer, J. (Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The importance of agricultural biomass conversion is evaluated on the basis of the results obtained from extensive research work. Evaluations of the state of the art, the management and agricultural integration prove to show that the present conditions do hardly allow an economic operation of small-scale individual biomass conversion plants. A future improved economic operation is above all expected to be brought about by higher energy profits (real rises in energy prices). Advantages could also result from a modification of biomass conversion plants and improvement of manure properties (better manuring results, reduction of odors). Biomass conversion communities are expected to stimulate and essentially contribute to an extensive utilization of biogas potentials. Complexes such as these could compensate and reduce the disadvantages of individual plants (e.g. little or no chances of consuming the gases produced during the summer season, high specific constructional and operational expenses) and be the beginning of economic biomass conversion plants.

45205 **(PB—87-210696/XAB) Biological gasification of renewable resources. Annual report, March 1984-February 1985.** Chynoweth, D.P.; Jerger, D.E.; Srivastava, V.J.; Conrad, J.R.; Mensinger, J.D. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1985. 127p. NTIS, PC A07/MF A01.

See also PB—87-153938.

The objective of the project was to determine the best reactor configuration and optimum operating conditions for anaerobic digestion of each of four prototype feeds - water hyacinth, kelp, sorghum, and poplar - representing feedstocks of varying particulate and lignin content. The results of anaerobic biogasification potential (ABP) assays and bench studies suggest that the best reactor design for water hyacinth may involve separate digestion of juice and solids fractions in attached-film and high-solids reactors, respectively. Best performance was obtained in a non-mixed vertical-flow reactor for seaweed and sorghum feeds. A novel short rotation form of poplar referred to as woodgrass exhibited a higher conversion rate and similar conversion yields as conventional short-rotation samples. A methane yield comparable to the ultimate expected (5.0 SCF/lb VS added) was achieved in a two-phase leaching-bed attached-film reactor receiving poplar that was not pretreated. Experiments were conducted with cellulose to determine mechanisms of inhibition observed at high solids concentrations during the methane fermentation of sorghum and poplar.

45206 **(PNL—6282) Biomass Thermochemical Conversion Program: 1986 annual report.** Schiefelbein, G.F.; Stevens, D.J.; Gerber, M.A. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014692.

Wood and crop residues constitute a vast majority of the biomass feedstocks available for conversion, and thermochemical processes are well suited for conversion of these materials. Thermochemical conversion processes can generate a variety of products such as gasoline hydrocarbon fuels, natural gas substitutes, or heat energy for electric power generation. The US Department of Energy is sponsoring research on biomass conversion technologies through its Biomass Thermochemical Conversion Program. Pacific Northwest Laboratory has been designated the Technical Field Management Office for the Biomass Thermochemical Conversion Program with overall responsibility for the Program. This report briefly describes the Thermochemical Conversion Program structure and summarizes the activities and major accomplishments during fiscal year 1986. 88 refs., 31 figs., 5 tabs.

45207 **Environmental design considerations for thermochemical biomass energy.** Brown, M.D.; Baker, E.G.; Mudge, L.K. (Pacific Northwest Lab., Richland, WA). *Biomass;* **11**: No. 4, 255-270(1986).

This paper discusses design considerations to be employed for control technologies which can minimize environmental damage and maximize operability in thermochemical conversion of biomass. Particulate and tar concentrations from both gasification and combustion technologies are examined. Applicable cleaning technologies and practical implementation of these technologies are discussed. 21 references.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 45708, 45709

45208 **(DOE/ER/13290—3) A surface science investigation of potential intermediates, catalysts, and promoters in the synthesis of higher alcohols by metals: Progress report.** Barteau, M.A. (Delaware Univ., Newark (USA). Center for Catalytic Science and Technology). 1987. Contract FG02-84ER13290. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014188.

The goal is to understand the elementary processes involved in the synthesis of methanol and higher alcohols on transition metals and the dependence of these processes on the surface. Techniques used include TPD, HREELS, and XPS. Results indicate that decomposition of higher alcohols on Pt-group metals proceeds via the reverse of alcohol synthesis pathways. Oxygen atoms adsorbed on Pd(111) play at least 5 roles in altering the selectivity of alcohol conversion on this surface. Although much of the network describing oxygenate chemistry on transition metals is general, the selectivity of these reactions depends strongly on details of surface-adsorbate and adsorbate-adsorbate interactions. (DLC)

45209 **(SERI/STR—231-3138) Economic feasibility study of an enzyme-based ethanol plant: A subcontract report.** (Stone and Webster Engineering Corp., Boston, MA (USA); Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 214p. NTIS, PC A10. File Number DE87001189.

This report presents an economic feasibility study of an enzyme-based ethanol plant. The objectives of the study were to determine the current economic status of the conversion of lignocellulose to ethanol via enzymatic hydrolysis and to make recommendations for further R & D. The results include an integrated process design, a capital cost estimate, an investment analysis, and R & D recommendations. The site for the enzyme-based ethanol plant is on the island of Hawaii, near the city of Hilo. The fill-scale plant will be capable of producing 15 million gallons per year of fuel-grade ethanol from eucalyptus wood chips. 52 refs., 311 figs., 26 tabs.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 45207, 45238, 45568, 46177

45210 **(ETSU-B—1136(d)) Refuse derived fuel combustion trials on a single chain grate stoker shell boiler.** Burnley, S.J. (Warren Spring Lab., Stevenage (UK)). 1987. 30p. (LR—573(MR)). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Refuse derived fuel (RDF) combustion trials were carried out on an Edwin Danks three pass shell boiler rated at 4.4 MW fitted with a single chain grate stoker. During two eight hour test periods an output of approximately 2.3 MW was achieved at a thermal efficiency of 81%. Flue gas particulate, heavy metal and acidic emissions were all below the recommended maximum levels. Boiler fouling was a major problem and the regular use of RDF would

require the boiler to be shut down for cleaning every week. Suggestions are made as to how this problem can be overcome.

45211 (ETSU-B—1136-(e)) **Combustion of refuse derived fuel on a fixed grate stoker shell boiler at Darleys Brewery, Thorne.** Burnley, S.J. (Energy Technology Support Unit, Harwell (UK)). 1987. 20p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Refuse derived fuel (RDF) combustion trials were carried out at Darleys Brewery, Thorne on a Hartley and Sugden three pass shell boiler fitted with a Greenforge fixed grate stoker. During a seven hour test an output of 2.07 MW was achieved at a thermal efficiency of 79%. This output represents 90% of maximum continuous rating (MCR), and the factor limiting the output was the speed of the fuel delivery system. The flue gas particulate emissions were in excess of the Clean Air Act limits and this is thought to be caused by the unnecessary reinjection of the grit arrestor deposits into the combustion chamber. There were no problems with boiler fouling. This represents a successful use of RDF and recommendations for system improvement are proposed.

45212 (ETSU-B—1172) **Market assessment for wood as fuel.** (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; P-E Consulting Services Ltd., Egham (UK)). Jan 1987. 108p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ .

The report presented summaries the findings of a market study to assess the potential acceptance of wood as a commercial fuel in SW England and the Southern half of Scotland; carried out during the period March to November 1986. The overall aim was to obtain information that would help achieve the successful market development of wood as a fuel. The principal objectives were to analyse available information on the supply and location of forestry waste, to profile potential industrial, commercial and institutional users of forestry waste as a fuel, to assess the scope for matching forestry waste supply with potential demands and to identify prospective host organisations for demonstration projects on the use of forestry wastes as fuel.

45213 (ETSU-R—40, pp 12, Paper 1) **Energetical use of straw in Austria.** Woergetter, M. (Federal Institute for Agricultural Engineering, AT. Department of Agricultural Engineering Research). May 1986. NTIS (US Sales Only), PC A05/MF AC1. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

Austria is a small country, situated in the middle of Europe. The federal republic is divided into nine federal provinces. Compared with the European average, the density of population is low. The energy supply depends on energy imports. A great part (approx. 1/3), is used for heating purposes. The most important fuels are oil, gas and coal. The percentage of renewable fuels is considerable. In 1983, 36,1 PJ fuel wood, 17,2 PJ combustible refuses and 0,5 PJ fuel straw were used. Experts have estimated an increase of straw from zero in 1978m, to 55 000 tons in 1984. Straw production, legislative regulations, straw handling, and combustion technologies, economic aspects, and research and development are reviewed.

45214 (ETSU-R—40, pp 3, Paper 2) **Straw combustion on farms in Denmark.** Keller, P. (Testing Station for Biomass Plants, DK). May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

In Denmark there are 2 mill. ton straw disposal for combustion purposes, and up till now only 0,7 mill. ton straw are used for this combusting purpose. Today there are about 15.000 straw boilers (20-500 kW) installed on danish farms. Of these 2/3 are constructed for small bales and 1/3 for roundbales or big bales (Heston). Since 1978 straw boilers have been tested at the National Agricultural Engineering Institute in Denmark, and 25 testing reports have been published. The development of straw boilers is discussed.

45215 (ETSU-R—40, pp 6, Paper 4) **Straw as fuel in France.** Gaudemard, S. (Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, CEMAGREF, 34 - Montpellier, France). May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

As in the other countries, the increase in prices of fossil fuels has greatly changed the energy supply in France. The renewable energy has a very small place in the French energy supply, however the light rise from 1 to 2 % from 1973 to 1984 shows a little interest in its development. The straw has the same evolution as the other biomass supply. In the face of the small percentage use of straw as a fuel, it is difficult to speak of the role of straw, as an energy supply in the future. Straw processing combustion technology and research and development are discussed.

45216 (ETSU-R—40, pp 3, Paper 6) **Straw as fuel. Status report from Norway.** Kjus, O. (Norwegian Institute of Agricultural Engineering, NO). May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

In Norway straw is practically not in use as a source for power and heat supply. In 1983 there were sold about 300 furnaces in which straw bales could be burnt, but most of the energy for these furnaces was taken from firewood. The net production of straw is estimated to 750 thousand tons. About 150 thousand tons of straw are annually used as feed for cattle. The rest is regarded as surplus and is burnt in the fields or it is ploughed into the soil. The potential role as an energy source in the future, harvesting costs and research and development are considered.

45217 (ETSU-R—40, pp 6, Paper 7) **Potential for straw utilisation in Ireland.** Lyons, G.J.; Burke, J.I. (Agricultural Institute, Carlow, IE. Oak Park Research Centre). May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

Very little statistical information is available on the production and utilisation of straw in Ireland. However, using average cereal production figures, the total straw yield is estimated to be over 1.7 million tonnes annually. Energy markets and the large potential market for direct combustion of biomass fuels, such as cereal straw are discussed.

45218 (ETSU-R—40, pp 2, Paper 8) **Seminar and Workshop on energetic use of straws. Spanish contribution to overall interchange data.** May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

The general landscape of energy supply in Spain is outlined. Spanish energy policy is planning for a 7% contribution from renewable sources by 1992. The main sources for biomass derived fuels are forestry and agricultural wastes (straw). Other sources may be cattle manures and slurries. The main problems in use of straw as fuel are low density and high ash content. The former requires considerable storage space as the waste is only available for 3 months; the latter creates an additional problem of final disposal of combustion ash.

45219 (ETSU-R—40, pp 4, Paper 9) **Straw as a fuel. A status report for Sweden.** Pahlstorp, S. (Department of Farm Building, Lund, SE). May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

The energy consumption in Sweden is high. A lot of effort has been made during the last 10 years to reduce the oil dependence. It has been calculated that Sweden has about 3 million tonnes of straw that could be used as fuel. Now it is ploughed in or burnt. Only 5% of this straw is used today. The total potential as fuel is about 12 TWh. The straw burning lobby is strong. About 10 straw burning units with output > 1 MW have been built. In the three main agricultural areas energy from straw burning units could be used for grain drying, district heating, etc.

45220 (ETSU-R—40, pp 6, Paper 10) **Straw as a fuel. A status report for the UK.** Martindale, L.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Support Unit). May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

The average yearly production of straw in the UK exceeds 13.7 million tonnes a year - equivalent to 7.0 million tonnes of coal. Approximately half is baled and used, primarily for animal bedding and feed. The surplus of 7.0 million tonnes a year (3.7 Mtce) is either burnt in the field (95%) or incorporated into the soil. This surplus, if collected, would meet over 1% of UK energy requirement. There is likely to be increasing pressure to find alternative markets and thereby reduce in-field burning, which together with anticipated changes in fossil fuel prices, will lead to it's use as fuel assuming considerable importance. On-farm use of straw as fuel can be cost effective now. Straw may also be used as an industrial and institutional fuel.

45221 (ETSU-R—40, pp 4, Paper 11) **European Cooperative Networks on Rural Energy.** May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

The main objectives of the European Cooperative Networks on Rural Energy (CNRE) are: to promote the more efficient use of traditional energy sources in agricultural production, and to increase the share of new and renewable sources of energy for and from rural sectors. The network cooperation includes: the organization of systematic exchange of scientific information, research and development experiences; the selection of well defined research topics; the collection and analysis of the results of national research programmes to prepare recommendations for the development of new energy technologies and the establishment and testing of experimental technologies to promote the practical application of new and renewable energy resources.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 45226

45222 **(DOE/CE/15309—T1) Flash gate board research: Progress report.** (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering). 1 Sep 1987. Contract FG01-87CE15309. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014204.

Static forces and dynamics were studied for a flash gate board installation around a dam. Flow and torque are plotted vs water height, at various gate angles. Moment of inertia was determined vs gate angle. Simulations were carried out on the effects of rainfall into the lake, on the system. (DLC)

1306 Environmental Aspects

45223 **(AD-A—181372/4/XAB) Environmental & water-quality operational studies: improvement of hydropower-release dissolved oxygen with turbine venting. Final report.** Wilhelms, S.C.; Schneider, M.L.; Howington, S.E. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Mar 1987. 109p. (WES-TR-E—87-3). NTIS, PC A06/MF A01.

This report summarizes various in-lake, in-structure, and downstream techniques to enhance the dissolved oxygen concentration of hydropower releases. In-lake and in-structure techniques appear to be the most applicable for Corps of Engineers projects because of the large discharges of most hydropower projects. Of these, the in-structure techniques, particularly turbine venting, appear very attractive considering cost and degree of improvement. Tests were conducted at the Clarks Hill Dam powerhouse to evaluate various aspects of turbine venting and thereby provide a data base to develop predictive and design capabilities for turbine-venting systems. Test results indicated that, at most, the oxygen deficit in the penstock could be reduced by about 30%, i.e., if the penstock oxygen deficit is 8.0 mg/(l), then, at most, about 2.4 mg/l of oxygen could be absorbed into the release flow. Two reaeration processes that contributed to the overall oxygen transfer were observed: (a) due to the turbulence in the tailrace area and (b) due to the air bubbles (vented through the turbine) as they traveled through the draft tube. A numerical computer model was developed that included the impact of the changes in thermodynamic (pressure) state as the bubbles passed through the draft tube. By developing the pressure time history, the increased potential for oxygen transfer due to the increase in hydrostatic pressure was included in model formulation. Good agreement was obtained in comparing model predictions and oxygen uptake data from previous tests at Clarks Hill.

45224 **(DOE/BP—868) Natural propagation and habitat improvement: Volume 1, Oregon: Final and annual reports, 1986.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). Jan 1986. 595p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE87014620.

This report describes activities implemented for fisheries habitat improvement work on priority drainages in the Clackamas and Hood River sub-basins. Separate abstracts have been prepared for the reports on individual projects. (ACR)

45225 **(DOE/BP/13076—2) Evaluation of management of water releases for Painted Rocks Reservoir, Bitterroot River, Montana: Final report.** Spoon, R.L. (Montana Dept. of Fish, Wildlife and Parks, Missoula (USA)). Aug 1987. Contract AI79-83BP13076. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87014302.

This study was initiated to develop a water management plan for the release of water purchased from Painted Rocks Reservoir. Releases were designed to provide optimum benefits to the Bitterroot River fishery. Fisheries, habitat, and stream flow information was gathered to evaluate the effectiveness of these supplemental releases in improving trout populations in the Bitterroot River. Approximately 15,000 AF of supplemental reservoir water was released annually into the Bitterroot River during summer periods from 1983 through 1986. Supplemental releases significantly enhanced summer flows upstream from Hamilton during all years, but were insufficient to maintain minimum flow recommendations in the dewatered section during years with low stream flow (1985 and 1986). Most water released failed to reach the dewatered section because of losses to irrigation withdrawals. The relatively low trout numbers observed in the dewatered section (Tucker), compared to the control section (Darby), indicate that poor stream flows adversely affect trout populations in the Bitterroot River. Supplemental releases from Painted Rocks Reservoir have enhanced the rainbow trout population in the control section (Darby). Rainbow trout numbers increased by over 200% during the period of releases. Minimum instream flow recommendations obtained from wetted perimeter-discharge relationships averaged 8.63 m^3/s (304 ft^3/s) in the Darby area, 11.41 m^3/s (402 ft^3/s) for the dewatered section, and 8.50 m^3/s (300 ft^3/s) for the section rewatered by irrigation returns. The minimum recommended flow for the lower segment of the West Fork of the Bitterroot River was 5.11 m^3/s (180 ft^3/s). A flow of 4.25 m^3/s (150 ft^3/s) provided the minimum depth and width criteria needed to float drift boats or rafts over the shallow riffle areas in the Bitterroot River.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 45550

45226 (DOE/S—0057, pp 197-210) **Renewable energy: An emerging resource.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

The combination of solar, wind, geothermal, water, and biomass energy represents an extremely large resource base that, over the long term, could become a major new source of energy supply. The majority of the renewable energy used in the world now comes from conventional big hydroelectric plants and wood fuel - both of which have only slight future growth potential. There are other types of renewable energy that might grow almost explosively in the early part of the next century, but these are the ones based on much higher technology. Their present high costs are likely to drop, rather than rise. Renewable energy can significantly reduce energy security problems - but only whenever and wherever it is available at a reasonable cost in sufficient quantities, and in the desired applications. Because the current cost of installing renewable energy systems is relatively high, however, the current prospect of low oil prices and certain deterrents to long-term investment are discouraging factors for renewable energy. The approach to achieving renewable energy's potential contribution is through a realistic, far-sighted effort to improve the technology base from which private enterprise can make development and investment decisions for the future. Strategies to help the renewable potential emerge as reality include continued research, active international energy collaboration, and a continued Federal leadership role. The DOE's renewable energy research program is structured to provide the private sector with the technology base it will need to develop competitive technologies in the critical areas required to reduce system costs, improve performance, and lengthen the operating lives of systems. One area of special interest will be fuels from renewable resources that in time could reduce the transportation sector's dependence on oil.

45227 (NP—7770269) **Project-related experiences by Dornier System Company in the field of energy technology.** (Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.)). Jun 1986. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770269.

This volume reports the experience gained by the Dornier System Company in projects related to the following topics: solar energy (including heat-tube solar absorber, solar sea-water desalination, solar energy utilization in fresh-water production, solar cold-storage house, small-scale 10 kW solar power plant, screw-type expander, solar heat pump, development of simple solar collectors, photo-electrochemical cells); wind energy (application potential of wind power plants in developing countries, wing technology programme, German-Indian development project for wind energy utilization); hydrogen technology (high-temperature steam-phase electrolysis, safety aspects, military application potential, hydride storage materials); rational energy utilization (coking, optimization of cooling and refrigerating devices, development of oxygen measurement probes); coal processing and mining technology (cutter head control for continuous miners); energy from biomass (bioconversion, fermentation alcohol from produce for use as biofuel, i.e. use of plant wastes in developing countries); other renewable energies (seawave energy, artificial geothermal energy systems). The volume is subdivided into 5 subtopics - solar energy, wind energy; hydrogen technology, bioconversion, rational energy utilization - each of which was entered with an associated abstract into the data base. (HWJ).

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 44856, 45188, 45189, 45190, 45191, 45192, 45193, 45195, 45196, 45197, 45201, 45202, 45203, 45204, 45206, 45207, 45209, 45213, 45214, 45215, 45216, 45217, 45218, 45219, 45220, 45221, 45522, 45820, 45944, 46038

45228 (CONF-870528—19) **Wide bandgap passivation layers on silicon.** Case, C.; Landis, G.; Beaulieu, R.; Loferski, J.; Vernon, S.M.; Spitzer, M.B.; Sekula, P.; Keavney, C.J.; Haven, V. (Spire Corp., Bedford, MA (USA); Brown Univ., Providence, RI (USA)). 1987. Contract AC02-84ER80186. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014307.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The research problem that has been addressed in this work is the deposition of ZnS, ZnS/sub 0.9/Se/sub 0.1/, and GaP, which are candidate lattice-matched wide bandgap materials intended to replace SiO_2 passivation on silicon solar cells. Ideally, these films would reflect minority carriers but not impede majority carrier transport to the surface and would passivate beneath contacts. The thin films were deposited by MOCVD, resistance evaporation or sputtering. Epitaxial GaP and ZnS films cause increases of internal quantum efficiency at short wavelengths. Reductions in J_0 comparable to that generated by SiO_2, and increases in V/sub oc/ were also observed. Film growth morphology was found to be a function of substrate temperature, orientation and the success of in situ removal of the native oxide.

45229 (CONF-871027—10) **Photocatalytic electrochemistry at a biological-membrane metal-colloid interface.** Greenbaum, E. (Oak Ridge National Lab., TN (USA)). 18 Oct 1987. Contract AC05-84OR21400. 2p. NTIS, PC A02. File Number DE87009122.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

A method for electrically contacting the electron-transport chain of photosynthesis is described. Colloidal platinum was prepared and precipitated directly onto photosynthetic thylakoid membranes from aqueous solution, and entrapped on fiberglass filter paper. This composition of matter was capable of sustained simultaneous photoevolution of hydrogen and oxygen when irradiated at any wavelength in the chlorophyll absorption spectrum. Experimental data support the interpretation that part of the platinum metal catalyst is precipitated adjacent to the photosystem-I reduction site of photosynthesis and the electron-transfer occurs across the interface between photosystem I and the catalyst. Photoactivity of the material was dependent on the nature of the ionic species from which the platinum was precipitated. When contacted with metal electrodes, the thylakoid-platinum combination is capable of generating a sustained flow of current through an external load resistor. 3 refs.

45230 (DOE/CH/10093—6) **Biofuels and municipal waste technology research program summary: FY 1986.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Biofuels and Municipal Waste Technology Div.). Jul 1987. Contract AC02-83CH10093. 372p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87001140.

An account of the ongoing research sponsored by the Biofuels and Municipal Waste Technology Division is provided in this volume. A description is given for each of the program projects funded and/or in existence during fiscal year 1986 (October 1, 1985 through September 30, 1986), reflecting its status as of September 30, 1986. The projects are grouped into programs directed towards short-rotation cultivation, herbaceous energy crops, aquatic species research, municipal wastes feedstock preparation, alcohol fuels, anaerobic digestion, thermochemical conversion, and regional programs.

45231 **(DOE/ER/10902—T1) Biochemical and physiological characterization of higher plants with reduced photorespiration: Final report for period May 25, 1981-May 24, 1985.** Chollet, R. (Nebraska Univ., Lincoln (USA). Dept. of Biochemistry). Aug 1987. Contract AC02-81ER10902;FG02-84ER13215. 9p. (DOE/ER/13215—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014015.

To further understanding of mechanisms which may reduce photorespiration in terrestrial higher plants, this project sought to critically evaluate the reported effects of nuclear gene dosage on the kinetic and structural properties of green leaf ribulose bisphosphate carboxylase/oxygenase (Rubisco). The results dispel earlier reports that nuclear gene dosage qualitatively affects the enzymic and physicochemical properties of leaf Rubisco, provides definitive evidence that proteolysis accounts for the large subunit charge microheterogeneity in higher plant Rubisco, indicate that ligand-induced changes in protein conformation are responsible for the formation of the exchange-inert Rubisco-carboxyarabinitol bisphosphate (CABP) complex, and provides the first experimental evidence for negative cooperativity in the CABP-Rubisco tight-binding reaction. A second objective was to elucidate the mechanisms by which photorespiration is reduced in various naturally occurring C_3-C_4 intermediate species of Moricandia, Panicum and Flaveria. The findings indicate that a C_4 acid-based CO_2-concentrating mechanism such as in C_4- or CAM-photosynthesis is not responsible for reducing photorespiration in the intermediate Moricandia and Panicum species, and provide the first direct experimental evidence to suggest that these C_3-C_4 species are capable of an enhanced photosynthetic recycling of photorespiratory CO_2 via Rubisco. 13 refs.

45232 **(DOE/ER/13627—1) Molecular cloning and structural characterization of the R locus of maize: Annual progress report for period September 29, 1986-September 28, 1987.** Dellaporta, S.L. (Yale Univ., New Haven, CT (USA). Dept. of Biology). Jul 1987. Contract FG02-86ER13627. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014149.

Last year we reported on the isolation of a molecular clone of the R locus of maize using an Ac transposon tagging strategy. During the past year we have confirmed the identity of this clone and have begun a molecular analysis of several R alleles. Our main focus continues to be on the analysis of R-r, an allele containing both seed (S) and plant (P) components. Genomic blot analysis and gene cloning experiments suggest that the R-r allele may be organized as a triplication. In addition to (P) and (S), there appears to be a third cryptic component we refer to as (Q). We are attempting to clone the complete R-r allele by chromosome walking techniques to determine the molecular organization of R-r. The second objective of our research on R is to understand the mechanism of tissue-specific regulation of anthocyanin. We are characterizing several R alleles that condition different pigmentation patterns in plant and seed tissues. In order to determine the allelic differences among tissue-specific components we have obtained genomic clones and are performing DNA sequence analysis to regions of several tissue-specific components that may be responsible for these allelic differences. 1 ref.

45233 **(ETSU-B—1051/1) Experimental studies on catch fuel crops. Final report.** Carruthers, S.P. (Rutherford Appleton Lab., Chilton (UK)). Jan 1984. 102p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Biofuels Research and Development Programme.

The potential for growing catch crops to provide a feedstock for anaerobic digestion to produce biogas, has been studied. It was concluded that yields of up to 6.5 t dry matter could be expected from late-July sowings declining to about 1.5 t dry matter from sowings in late-August/early September. On the basis of recent data on main crop areas and yield from the field experiments, the potential output of the UK tillage area was estimated as 72 - 162 PJ biogas per year (depending on anaerobic digestion efficiency). Assessments of economic potential suggest that biogas could be produced from catch crops at costs comparable to conventional fuel prices, but that appreciable fuel price increase would need to occur before biogas generation was competitive with the use of catch crops as animal feed.

45234 **(ETSU-B—1051/2) Experimental studies on catch fuel crops. Annex 1: field experiment 1980.** Carruthers, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Jan 1984. 147p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Biofuels Research and Development Programme.

The effects of sowing date and seed rate on the growth and yield of fodder radish, white mustard, stubble turnip and rape were studied. Qualitative observations, crop leaf surface development and crop dry matter production are discussed. Results indicated that above ground yields of 6.4 tOM per ha can be obtained from crops sown in later July declined to 1.6 tOM per ha if sown in mid-September.

45235 **(ETSU-B—1051/3) Experimental studies on catch fuel crops. Annex 2: field experiment 1981.** Carruthers, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Jan 1984. 151p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Biofuels Research and Development Programme.

The effects of sowing date and seed rate on the growth and yield of stubble turnip and fodder radish were investigated, and the percentage of light interception and relation between light interception and crop yield were examined. Qualitative observations, crop leaf surface development and crop dry matter production are discussed.

45236 **(ETSU-B—1051/4) Experimental studies on catch fuel crops. Annex 3: field experiment 1982.** Carruthers, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Jan 1984. 56p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Biofuels Research and Development Programme.

The effects of sowing date on the growth and yield of stubble turnip and on the efficiency of light interception and dry matter production were investigated in terms of incident and intercepted light. The latter was assessed by percentage ground cover and leaf area index, which was measured using a T-meter and a photometer.

45237 **(ETSU-B—1102) Growing wood for energy in Great Britain. (The land availability study).** Mitchell, C.P.; Tranter, R.B.; Downing, P.; Brandon, O.; Pearce, M.L.; Bunce, R.G.H.; Barr, C.J. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 196p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Biofuels Programme.

The extent to which energy forestry might compete with present land uses, was studied in order to estimate the potential for energy forestry to contribute economically to the national energy demand, to identify the present land uses which might be most affected by exploitation for energy forestry, and to indicate what effect non-agricultural, or social factors might have on this economic potential. A land use model was developed under the study. It was concluded that a significant potential for energy forestry does exist.

45238 (ETSU-R—40, pp 8, Paper 5) **Use of alternative energy sources for corn drying and stable heating in Hungary.** Kocsis, K. (Agrartudomanyi Egyetem, Goedoelloe, Hungary). May 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752935. (CONF-8603212—).

From International workshop on straw as fuel; Cambridge, UK (4 Mar 1986).

Over the last decade the total energy consumption of Hungarian agriculture has doubled and in 1978 reached 1.7 million toe. The share of heating oil has also grown very fast and in 1978 reached a peak of 0.68 million t. About 380 thousand t heating oil was used for drying, of which 220 thousand t for corn and 120 thousand t for alfalfa and some 180 thousand t for stable heating, mainly for poultry (120 thousand t) and pigs (40 thousand t). Because of the expected oil shortages and skyrocketing energy prices, definite measures were taken to reduce the heating oil demand of

agricultural production, develop energy saving technologies and replace fossil fuels with various alternative energy sources, like agricultural residues, biogas, geothermal and solar energy.

45239 (IFU-B—14-86, pp 12-19) **Present and future situation of biogas research in Austria.** Lafferty, R.M. (Technische Univ., Graz, Austria. Inst. fuer Biotechnologie, Mikrobiologie und Abfalltechnologie). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The paper reviews the development of biogas production in Austria. New trends can for example be observed in the field of methane fermentation processes. The new methods of biotechnology, e.g. the modelling and optimization of bioprocesses as well as the application of genetechnology are expected to be improving future biomass conversion.

45240 (IFU-B—14-86, pp 20-24) **Structure and aims of the Austrian biogas research programs.** Zellhofer, O. (Bundesministerium fuer Wissenschaft und Forschung, Vienna, Austria). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

One of the relevant research programs consisted in the construction, operation and improvement of three biomass conversion plants of the Edelhof research and demonstration center (MET, BVT and ETERNIT being the companies in charge), two biomass conversion plants in the Steiermark region (Harrer, Trummer) and one on the premisses of the Federal Institute for Agricultural Technology, Wieselburg. Process optimization studies, among others, involved microbiological, chemical engineering and thermodynamic aspects. The development of analytical methods for biomass conversion plants, the cultivation of starter bacterial, development of a manure/manure heat exchanger or new heating systems as well as research into the development of biogas desulfurization procedures contributed to the improvement of the respective plants and establishment of an optimal general system.

45241 (IFU-B—14-86, pp 31-72) **'Harrer' and 'Trummer' biomass conversion plants.** Padinger, R. (Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

Both the 'Harrer' cattle manure biomass conversion plant (Stenzengreith near Weiz/Steiermark region) and 'Trummer' chicken manure/swine manure biomass conversion plant (Gnas/Steiermark region) were installed as pilot plants on the initiative of the Austrian biogas research. Both plants are considered prototypes in what concerns their constructional and operational features. Apart from being used for gas production purposes they served to test different individual components and analyze fermentation processes under different conditions. Measuring instruments and equipment allowing different modes of operation provided for the realization of above functions.

45242 (IFU-B—14-86, pp 147-152) **Experiences gained in the operation of the BVT BIMA biomass conversion plant installed on the premises of the Edelhof biogas research and demonstration center, Austria.** Manahl, R. (Biologische Verfahrenstechnik G.m.b.H., BVT, Bregenz, Austria). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

Two series of tests (1983 - March 1984 and 1985, respectively) investigated into the anaerobic digestion of swine and cattle manures on a semi-industrial scale. The BIMA plant (Biologische Verfahrenstechnik, Bregenz) struck by its by percentage lowest energy demand and most efficient gas production of the three systems installed on its premises. The results obtained in 1985 serve to describe the BIMA plant and its different uses.

45243 **(NP—7770259) Biogenic raw materials.** (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 108p. (In German). NTIS (US Sales Only), PC A06. File Number DE87770259.

In the framework of the programme 'Applied Biology and Biotechnology' of the Federal German Government, the Federal Ministry for Research and Technology has devised a research promotion concept for the main field 'plant breeding and biogenic raw materials'. The practical application of the scientific results is supported above all by the Federal Ministry for Agriculture and the Commission of the European Communities.

45244 **(PB—87-200937/XAB) Characteristic improvement of amorphous silicon solar cell for indoor use.** Mori, K.; Hanafusa, A.; Umeo, Y. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). Oct 1986. 7p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 132-138(Oct 1986).

Because amorphous silicon solar cells are easily fabricated by the plasma CVD method and it is possible to obtain a large-area thin film, they have been expected to be the most-promising low-cost solar cells, and have been studied and developed actively by various groups. They have been used for indoor consumer products, such as calculators, watches and clocks, but they are also coming to be used as outdoor portable power supplies. A new amorphous silicon solar-cell has been developed for use in calculators and remote-control units of TV sets. Through studies of the transparent electrode, the optimum conditions of p-type doped amorphous silicon carbide and the low-level boron doping technique to the i-layer, in the structure of glass/ITO/pin/metal, the newly developed amorphous silicon solar-cell has efficiency 30% higher than conventional ones under fluorescent light.

45245 **(PB—87-207635/XAB) Tissue-culture investigations into mechanisms of biomass enhancement. Annual report, June 1985-July 1986.** Nabors, M.W. (Colorado State Univ., Fort Collins (USA). Dept. of Botany and Plant Pathology). Jul 1986. 28p. NTIS, PC A03/MF A01.

See also PB—86-132818.

The development of energy crops, such as sorghum and Napier grass, with increased stress resistance or nitrogen-use efficiency, could greatly improve the cost effectiveness of biomass production. Plant tissue culture could provide a means to rapidly and economically provide rare and valuable variants to plant breeders, geneticists, and physiologists. To this end, efficient in-vitro culture systems were developed for several cultivars of sorghum bicolor and Pennisetum purpureum. In-vitro selection methods for production of cell lines with increased resistance to salt, drought, and improved fertilizer use were developed and plants arising from these cell cultures obtained. Evaluation of tissue-culture-derived germplasm for the presence of desired, variant traits has progressed via greenhouse screenings, biochemical assays, and field-evaluation techniques.

45246 **(SERI/STR—211-3174) $CuInSe_2$ solar cell research by sputter deposition: Annual subcontract report, 1 January 1986-31 December 1986.** Thornton, J.A.; Lommasson, T.C.; Talieh, H. (Illinois Univ., Urbana (USA). Coordinated Science Lab.; Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC02-83CH10093. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001184.

This report contains results of research on $CuInSe_2$ solar cells by sputter deposition. Most of the $CuInSe_2$/CdS devices fabricated from $CuInSe_2$ deposited by reactive sputtering have been characterized by relatively low open-circuit voltages. Typical values range from 0.22 to 0.32 V. A contributing factor may be the lower In composition in the top layer of composite two-layer $CuInSe_2$ films (Cu-rich base layer, In-rich top layer) that we used in cell fabrication. The reason for the lower In content is an In rejection process occurring during deposition at elevated temperatures. Therefore, the major emphasis of this work was to increase the In content in the top layer of $CuInSe_2$ films deposited in composite

two-layer configurations on Mo-coated, glass substrates. Variations in the relative currents to the Cu and In sputtering sources, the H_2Se injection rate, and the substrate temperature were explored. A temperature decrease from 450° to 400°C increased the In composition from 25 at. % to about 27 at. %. A second approach, in which the In sputtering source was operated for a short time with no Cu sputtering, also yielded promising results.

45247 **(SERI/STR—211-3188) Gallium arsenide and multibandgap solar cell research: Final subcontract report, April 1984-April 1986.** Vernon, S.M.; Tobin, S.P.; Wolfson, R.G. (Spire Corp., Bedford, MA (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012260.

This report presents results of research in high-efficiency, low-cost solar cells, emphasizing heteroepitaxial growth of a III-V compound material onto a single-crystal silicon wafer. The report describes the start-up and characterization of a new metal-organic vapor deposition (MOCVD) reactor for the growth of GaAs, GaAlAs, and GaAsP on 2-in.-diameter substrates with excellent uniformity; optimization of the growth of Ge films on Si by a simple CVD technique; and production of a 9% efficient GaAs-on-Ge-on-Si solar cell. The advancements in the understanding of the GaAs-on-Si growth process and in the quality of the films are described. The work also included production of a 7% efficient GaAs-on-Si cell; development of a GaAsP-on-GaAs growth technology; production of a 16.5% efficient GaAsP cell and a 17.7% efficient GaAlAs cell on GaAs; and production of a 20.8% efficient GaAs-on-GaAs cell. Also described are improvements in cell processing technologies, including the use of a double-layer antireflection coating.

45248 **(SERI/STR—211-3190) Preparation and properties of evaporated CdTe films: Final subcontract report, 16 February 1985-31 March 1987.** Bube, R.H.; Fahrenbruch, A.L.; Chien, K.F. (Stanford Univ., CA (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012270.

Previous work on evaporated CdTe films for photovoltaics showed no clear path to successful p-type doping of CdTe during deposition. Post-deposition annealing of the films in various ambients thus was examined as a means of doping. Anneals were done in Te, Cd, P, and As vapors and in vacuum, air and Ar, all of which showed large effects on series resistance and diode parameters. With As, series resistance values of In/p-CdTe/graphite structures decreased markedly. This decrease was due to a decrease in grain boundary and/or back contact barrier height, and thus was due to large increases in mobility; the carrier density was not altered substantially. Although the series-resistance decreases were substantial, the diode characteristics became worse. The decreases were not observed when CdS/CdTe cells were fabricated on Te vapor-annealed films. Preparation of ZnO films by reactive evaporation yielded promising results. Deposition of p-ZnTe films by hot-wall vapor evaporation, using conventional techniques, yielded acceptable films without intentional doping.

45249 **The transient and periodic illumination of a semiconductor - semiconductor-electrolyte interface.** Verbrugge, M.W.; Tobias, C.W. (Physical Chemistry Dept., General Motors Research Labs., Warren, MI 48090-9055). *Journal of the Electrochemical Society;* **134**: No. 6, 1437-1445(Jun 1987).

The analysis of the response of a photoelectrochemical system to a variable light source offers a convenient means for the characterization of a semiconductor-electrolyte interface. The authors present analytic solutions for the minority carrier concentrations at the semiconductor surface during pulse, step, sinusoidal, and periodic-square-pulse illumination. The analytic solutions can be used to describe the low level injection behavior of wide bandgap semiconductors employed in photoelectrolysis cells and other photoelectrochemical systems.

45250 **Directional thermal infrared exitance distributions of a deciduous forest in summer.** Balick, L.K.; Hutchison, B.A.; Smith, J.A.; McGuire, M.J. (EG and G Energy Measurements, Inc., Las Vegas, NV 89120). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Geoscience and Remote Sensing;* **GE-25**: No. 3, 410(May 1987).

Directional measurements of effective radiant temperatures (ERT) were made from a rotating mount suspended above an Oak-Hickory canopy. A directional ERT distribution is presented showing fairly weak trends with view angle. Additional data are presented to illustrate the character of spatial variations of ERT as a function of view and sun angle.

45251 **Current status of photovoltaic research at SERI.** Deb, S.K. pp 44-57 of Materials and optics for solar energy conversion and advanced lighting technology; Proceedings of the Meeting, San Diego, CA, Aug. 19-21, 1986. Lampert, C.M.; Holly, S. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The purpose of the Solar Energy Research Institute's photovoltaic cell development program is to conduct high risk, potentially high-payoff R&D leading to a more substantial knowledge base for exploitation by private concerns interested in the electrical energy market. Attention is presently given to the status of research and development for crystalline and amorphous silicon, polycrystalline $CuInSe_2$ and CdTe thin-film, and high efficiency III-V compound solar cells. Comparative efficiencies and economies are presented in tabular form, together with schematics of promising solar cell layer structures. 17 references.

1406 Photovoltaic Power Systems

45252 **(BSRIA-TN—4-87) Prospects for photovoltaic power supplies in buildings. Technical note.** Gregory, D.P. (Building Services Research and Information Association, Bracknell (UK)). Apr 1987. 18p. Building Services Research and Information Association, Old Bracknell Lane West, Bracknell, Berks., RG12 4AH.

The technology of photovoltaic cells is advancing rapidly, with efficiency improvements and cost reductions as the principal goals of "multi-million" sized research programmes in Europe, USA and Japan. Many projects are directed towards central-station power, but a significant number are for power supplies for individual or groups of buildings. Solar incidence levels in the UK are quite low, and roof-mounted systems without grid connection would need 500 m^2 or more of area for every 1 kW constant power output in winter, and are not likely to become economically attractive. Grid-connected systems which can merely augment conventional power supplies are slightly more appealing. Designers who are asked to consider building installations in remote areas, particularly in overseas sunny climates should consider photovoltaics now especially for uninterruptible power supplies, up-market residences and communications systems.

45253 **(N—87-23696) Space station WP-04 power system. Volume 2: Study results. Final study report.** Hallinan, G.J. (Rockwell International Corp., Canoga Park, CA (USA)). Jan 1987. 556p. (NASA-CR—179587; NAS—1.26:179587; FSR-DR—15). NTIS, PC A24/MF A01.

Results of the phase B study contract for the definition of the space station Electric Power System (EPS) are presented in detail along with backup information and supporting data. Systems analysis and trades, preliminary design, advanced development, customer accommodations, operations planning, product assurance, and design and development phase planning are addressed. The station design is a hybrid approach which provides user power of 25 kWe from the photovoltaic subsystem and 50 kWe from the solar dynamic subsystem. The electric power is distributed to users as a utility service; single phase at a frequency of 20 kHz and voltage of 440VAC. The solar array NiH_2 batteries of the photovoltaic subsystem are based on commonality to those used on the co-orbiting and solar platforms.

45254 **(SAND—87-0162C-FP) The fundamentals of photovoltaic system electrical design.** Menicucci, D.; Key, T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-8706101—1; CONF-870711—2-FP). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009061.

From American Solar Energy Society annual meeting; Portland, OR, USA (1 Jun 1987).

Over the past ten years research and development has led to the successful design and construction of many terrestrial photovoltaic (PV) systems. Much attention has been given to new and better designs for photovoltaic arrays and other system components. However, the design for electrical subsystems has evolved more on a case-by-case basis and no attempt has been documented to develop a standardized approach. This paper combines unique PV field experience with proven electrical design practices to provide fundamental design guidance for wiring, grounding and protection of photovoltaic power systems. Design criteria are identified and electrical subsystem design practices are recommended for several classes of residential, commercial, and industrial PV applications.

45255 **(SAND—87-0767) Power conditioning development for grid-connected residential photovoltaic applications.** Key, T.S.; Leeman, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014310.

As part of the National Photovoltaic Development Program, a research and evaluation activity has been carried out to develop low-cost, efficient residential power conditioning subsystems that are safe, acceptable to utilities, and compatible with photovoltaic arrays. The goals for residential-sized power conditioning as set forth in the Department of Energy 5-Year Photovoltaic R and D Plan are an energy conversion efficiency of 95% and a cost of $.30 per watt of ac power rating. Progress toward these goals includes identification of performance requirements, development and testing of prototypes, and projection of future hardware costs. These developments are discussed. Different power conversion technology options are compared with respect to meeting the cost and performance goals. Both line-commutated and self-commutated design approaches have been considered. We have determined that performance and cost goals can be best achieved by applying anticipated advancements in power electronics technology to photovoltaic power conditioning.

45256 **Photovoltaic concentrator array evaluation.** Maish, A.B. (Sandia National Labs., Div. 6224, Albuquerque, NM 87185). pp 373 of Proceedings of Intersol 85. Winnipeg, Manitoba Canada; Solar Energy Society of Canada (1985). (CONF-850604—).

From INTERSOL '85 - Solar energy--the diverse solution; Montreal, Canada (23 Jun 1985).

Photovoltaic (PV) concentrator arrays are tested at the Sandia PV test facility in order to characterize the performance of the array subsystems during baseline tests and to evaluate array performance during life tests. Array testing is designed to evaluate the complete array system (modules, structure, drives and tracking controls) following module development and qualification testing. Module qualification tests include accelerated tests of cell assemblies to give an indication of long-life potential. Although array tests at the Sandia facility do not include a sufficient number of arrays nor a sufficient test period to quantify array degradation and performance for a 30 year life, they will confirm the reliability of major design features and fabrication techniques of prototype arrays before more extensive testing is initiated. Array tests also provide useful input to the module and array development efforts. The described array test program provides a procedure for assessing array subsystem performance and for obtaining baseline modules and array performance measurements against which later measurements can be compared. The test program has provided valuable information on array performance and durability which has led to improved module and array designs and fabrication procedures.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 45253

45257 **(DOE/CH/10093—12) Solar thermal technology: Annual report, Fiscal Year 1986.** (Sandia National Labs., Albuquerque, NM (USA); Sandia National Labs., Livermore, CA (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 190p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87001171.

The research and development (R and D) described in this document was conducted within the US Department of Energy's (DOE) Solar Thermal Technology (STT) Program. This annual report is divided into two parts. Part I describes the accomplishments and progress of government-funded activities initiated, renewed, or completed during Fiscal Year (FY) 1986 (October 1, 1985, through September 30, 1986). It highlights the program tasks conducted by participating national laboratories and by contracting industrial, academic, or other research institutions. The focus of the STT Program during the year was research and development leading to the economic viability of two primary solar thermal concepts, central receiver and parabolic dish. Part II details the FY 1986 contract descriptions. These are followed by three appendices covering contacts, acronyms and abbreviations, a glossary, and a contractor index. A comprehensive bibliography of solar thermal technology publications is located after the appendices.

45258 **(SAND—87-1258) Proceedings of the solar thermal technology conference.** Tyner, C.E. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 358p. (CONF-870875—Absts.). NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87014441.

From Solar thermal technology conference; Albuquerque, NM, USA (26 Aug 1987).

The Solar Thermal Technology Conference was held on August 26-28, 1987, at the Marriott Hotel, Albuquerque, New Mexico. The meeting was sponsored by the United States Department of Energy and Sandia National Laboratories. Topics covered during the conference included a status summary of the Sandia Solar Thermal Development Project, perspectives on central and distributed receiver technology including energy collection and conversion technologies, systems analyses and applications experiments. The proceedings contain summaries (abstracts and principal visual aids) of the presentations made at the conference.

45259 **(SAND—87-1426) Direct Absorption Receiver flow experiments.** Chavez, J.M.; Tyner, C.E.; Couch, W.A. (Sandia National Labs., Albuquerque, NM (USA)). 1 Sep 1987. Contract AC04-76DP00789. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014655.

In a solar central receiver system Direct Absorption Receiver (DAR), the heat absorbing fluid (a blackened molten nitrate salt) flows in a thin film down a vertical panel (rather than through tubes as in conventional receiver designs) and absorbs the concentrated solar flux directly. To better understand flow phenomena in this type of receiver, we are conducting flow tests using water (because its flow properties are similar to molten salt) and a 3 MWt solar-heated DAR panel research experiment using salt. In this paper we discuss the results of the water flow testing, including manifold development, film stability, wave phenomena, and wind and natural convection effects on flow. In addition, we describe the design of the panel research experiment and planned testing.

45260 **(SAND—87-7013C) Demonstration of a personal computer based dynamic simulation and control system analysis tool used to evaluate and tune the major control loops of the Sandia Central Receiver.** Greenlee, T.L.; Ringham, M.; Reiley, G.; Kolb, G. (ESSCOR, San Diego, CA (USA); McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870987—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013997.

From IEEE international workshop on control systems in new energy applications; Madrid, Spain (28 Sep 1987).

The Central Receiver Test Facility was designed and constructed to serve as a test-bed for advanced solar receiver system concepts. In its current configuration, it consists of a 5 MW solar receiver (2 adjacent panels of 18 passes - 6 tubes per pass) through which molten salt is circulated. The heated salt is pumped to thermal storage from which it is extracted to produce 950°F steam at 1100 psia. An interactive model (IBM-PC/AT) of the solar receiver and thermal storage system has been developed for evaluation of system (process and control) performance. The model runs 50% faster than real time and compares favorably with a more detailed mainframe model.

45261 **(SAND—87-8178) Assessment of central receiver solar thermal enhanced oil recovery systems.** Gorman, D.N. (Thermal Power Systems, Larkspur, CO (USA); Sandia National Labs., Livermore, CA (USA)). Jul 1987. Contract AC04-76DP00789. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87014626.

In November 1982, ARCO Solar, Incorporated, with the cooperation of ARCO Oil and Gas Company, completed installation and began operation of a central receiver solar thermal pilot plant to produce steam for enhanced oil recovery. The highly automated plant can produce approximately one megawtt of thermal power in the form of 80% quality steam, which is delivered to a distribution header for injection into heavy oil formations. An engineering evaluation of data from the ARCO plant has been performed, with the conclusion that central receiver solar systems can be very effective sources of power to generate steam for the enhanced recovery of heavy oil. The highly automated pilot plant exhibited outstanding reliability of the solar power conversion components while operating routinely with a single attendant, demonstrating the capability for very low operating and maintenance costs for these systems relative to the use of conventional oil-burning steam generators. This document reports the operating and performance characteristics of the ARCO solar thermal enhanced oil recovery (STEOR) system over a full year of operation. System sizing and performance projection for a much larger commercial plant is also presented.

45262 **(SERI/TR—255-2993) DTA/DSC studies of phase equilibria in binary mixtures of barium carbonate with alkali carbonates.** Mills, R.E.; Coyle, R.T. (Louisville Univ., KY (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001195.

Phase diagrams for binary mixtures of $BaCO_3$ with K_2CO_3, Na_2CO_3, or Li_2CO_3 have been prepared using data for melting enthalpies and temperatures obtained from differential thermal analysis experiments. The information will contribute to determining if $BaCO_3$ is acceptable as a partial replacement for Li_2CO_3 in mixtures of these carbonates used as heat transfer and storage media in central solar receivers.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 45651

45263 **(DTH-LV—176) International Energy Agency solar heating and cooling programme. Task VIII. Passive and hybrid solar low energy buildings. Simulation model validation using test cell data.** Moerck, O.C. (ed.). (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jun 1986. 165p. NTIS (US Sales Only), PC A08/MF A01. File Number DE87752863.

Simulation programs play an important role in the design of passive and hybrid solar low energy buildings. Because of the complexity of these programs and the continuing development of new routines and entirely new programs, a need for validation is evident. Within Task VIII, Passive and Hybrid Solar Low Energy Buildings of the Solar Heating and Cooling Programme of the International Energy Agency a validation study has been undertaken for the most prominent simulation programs of today. The study comprised three empirical validation test cases: Direct Gain, Trombe Wall and Attached Sunspace, followed by code-to-code comparisons on yearly data sets. This report documents the three activities and includes also introductory paragraphs to general modelling techniques and to validation methodology.

45264 **(ENEA-RT/FARE—85/6) Technical economical analysis of the savings from passive solar technology in residential buildings.** Fanchiotti, A.; Manna, C.; Matteoli, S. (Istituto Universitario di Architettura, Venezia (Italy); ENEA, Casaccia (Italy). Dipartimento Fonti Alternative e Risparmio Energetico; Studio Matteoli, Roma (Italy)). 1985. 37p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900989.

A recent Energy Conservation Act enables Regional Administrations, among other things, to finance energy savings projects in the building sector, based on a technical-economic analysis. Passive solar technologies, due to the non-linearity and time-dependence of all phenomena, require analyses that are more complex than other cases. The method described in this paper solves these problems through simplifications that, while assuring acceptable levels of reliability, allow an easy access to non-technical users.

45265 **(NEI-DK—36) In situ check of solar water heaters.** Nielsen, J.E. (Teknologisk Inst., Tastrup (Denmark)). Oct 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752859.

A procedure for in situ check of solar water heaters are developed and described. Following this procedure you can check if an user installed solar system is performing as expected. The procedure requires one day of measurements and a couple of hours data-treatment and calculations.

45266 **(PB—87-201315/XAB) Cost reduction of the Sun Challenger (trade mark) batch solar water heater. Final report, 31 March 1986-30 April 1987.** Stickney, B.L. (Coyne Solar Mfg. Co., San Juan Pueblo, NM (USA)). May 1987. 38p. NTIS, PC A03/MF A01.

A variety of materials and methods were investigated as a means to reduce the cost of the Sun Challenger Solar Collector. Three prototypes were constructed and tested using lower-cost methods. Test results are summarized, including heat gain, heat loss, and collection efficiency. Costs and benefits are also presented and summarized.

45267 **(SWEG-TR—28) Performance of the solar heating system at St. Saviours Hospital, Jersey.** Waller, R.F. (South West Energy Group, Exeter (UK)). Jun 1985. 27p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The performance of the solar heating system at St Saviours' Hospital, Jersey which provides preheating for domestic hot water for a new residential block for 32 severely handicapped patients is discussed. The system was commissioned in May 1982. The design of the system and the design and performance of the logger and sensors are considered. The solar system has an output of some 6,000 kWh pa or approximately 25% of the domestic hot water load. The simple payback period is 98 years but this is due to low-loading of the system.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 45256

45268 **Flat-plate versus concentrator photovoltaic systems-Comparative insolation energy production and economic analysis.** Herwig, L.O. (Photovoltaic Energy Technology Div., U.S. Dept. of Energy, Washington, DC 20585). pp 372 of Proceedings of Intersol 85. Winnipeg, Manitoba Canada; Solar Energy Society of Canada (1985). (CONF-850604—).

From INTERSOL '85 - Solar energy--the diverse solution; Montreal, Canada (23 Jun 1985).

Several types of tracking concentrator and tracking and fixed-latitude-tilt flat-plate collector systems are analyzed to compare the effective incident insolation, the delivered energy and the estimated cost of the electrical energy produced at a variety of U.S. sites. The collector systems include a concentrator two-axis-tracking (C/TAT) system, a flat-plate two-axis-tracking (FP/TAT) system, a flat-plate single-axis-tracking (FP/SAT) system, and a

flat-plate fixed-latitude-tilt (FP/FLT) system. Improved insolation data, based upon measurements of direct and total radiation on tracking, fixed-tilt hand horizontal surfaces, is used directly or in conjunction with improved algorithms, to calculate the ratios of effective radiation energy entering the collector planes of any selected collector systems. These improved insolation data are obtained and interpreted by the Insolation Assessment and Instrumentation Branch of the Solar Energy Research Institute at Golden, CO. The author concludes that concentrator systems, under the efficiency assumptions used, can be competitive in producing electrical energy over a large part of the U.S. The ratio of system costs is the next major factor to consider in evaluating the relative cost of energy produced by selected systems located at the various sites.

45269 **Development of a stand-alone photovoltaic collector system using Fresnel lens air-cooled concentrators.** Mc Danal, A.J.; O'Neill, M.J. (ENTECH, Inc., P.O. Box 612246, Dallas-Fort Worth Airport, TX 75261). pp 375 of Proceedings of Intersol 85. Winnipeg, Manitoba Canada; Solar Energy Society of Canada (1985). (CONF-850604—).

From INTERSOL '85 - Solar energy--the diverse solution; Montreal, Canada (23 Jun 1985).

A system using the first generation hybrid photovoltaic and thermal (PVT) array design has been in operation for about two years at the DFW Airport and has exhibited excellent system performance and reliability. The authors have recently completed checkout testing of a 22 KW (electric)/100 KW (thermal) system of their second generation PVT design at Sandia National Laboratories, Albuquerque, New Mexico. Thus, both of the authors' design generations have been demonstrated in full-scale operational systems. Under a module development effort, an air-cooled photovoltaic module is developed and has undergone extensive performance and environmental cycling tests at ENTECH and Sandia. The results of analytical design studies, prototype module performance results as well as prototype stand-alone array system performance will be presented. The results of a market assessment (both U.S. and world-wide markets), design guidelines based on the market study (basic system size, system voltage, environmental design conditions) and system cost estimates on a production scale will be included.

45270 **Development of a crossed lens photovoltaic concentrator.** Mc Danal, A.J.; O'Neill, M.J. (ENTECH, Inc., P.O. Box 612246, Dallas-Fort Worth Airport, TX 75261). pp 374 of Proceedings of Intersol 85. Winnipeg, Manitoba Canada; Solar Energy Society of Canada (1985). (CONF-850604—).

From INTERSOL '85 - Solar energy--the diverse solution; Montreal, Canada (23 Jun 1985).

Over the past seven years, ENTECH (including its predecessor organization, E-Systems Energy Technology Center) has developed photovoltaic concentrator systems which utilize a patented, transmittance-optimized linear Fresnel lens as the optical concentrator. Both air-cooled photovoltaic collectors and hybrid photovoltaic and thermal (PVT) collectors have been developed with demonstrated electrical conversion efficiencies above 14% of 28 degree C cell temperature. Additionally, independent cost studies by Sandia and General Electric Company have concluded that the mass-production economics of these systems will be excellent. However, the major cost element in the authors' current systems is the photovoltaic cell itself, despite the 40X geometric concentration ratio utilized in our collector. To reduce this cell cost dramatically, the authors developed a new collector module which utilized a novel optical concentrator approach. In addition to offering substantial mass-production cost savings (at least /1 per peak watt due to silicon cell area reduction) compared to our current linear Fresnel lens collectors, the new crossed lens concentrator provides a 15.5% peak conversion efficiency, based upon our combined optical/electrical/thermal analyses. Prototype crossed lens modules are fabricated and undergoing performance testing in early 1985. The results of the analytical design studies and prototype module test results are presented.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 45226

45271 **(DOE/CE—0196) Geothermal progress monitor: Report No. 10.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Geothermal Technology Div.). Jul 1987. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014448.

This issue synthesizes information on all aspects of geothermal development in this country and abroad to permit identification and quantification of trends in the use of this source of energy. The contents include: (1) the Federal Beat; (2) The Industry Scene; (3) Financing; (4) Development Status; (5) Leasing and Drilling; (6) State and Local; (7) International; and (8) Technology Transfer. (ACR)

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 45275

45272 **(BMFT-FB-T—86-174) Magma content and temperature of the magma chambers of Lake Laach and the Rieden volcano. Final report.** Bogaard, P. van der; Viereck, L.G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Bochum Univ. (Germany, F.R.). Inst. fuer Mineralogie). Dec 1986. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770256.

In the Quaternary volcanic field of the E-Eifel two potential Hot-Dry-Rock magma systems have been studied by field, petrographic and petrologic methods. The Rieden magma system appr. 0.5-0.35 Ma old had six repetitive eruptions of differentiated phonolithic magma, each about 0.5 km/sup 3/ in volume. The magma chamber with a minimum volume of some 5 km/sup 3/ is located at appr. 3 km depth with its top. Model calculations indicate that it very likely is completely solidified and the surface heat flow density maximum has passed its peak. The 0.01 Ma old Laacher magma system only erupted once so far with a volume of 5.2 km/sup 3/ of differentiated phonolithic magma with a temperature of 800-900/ sup 0/C. In the most likely model the top of the magma chamber which has a volume of some 16 km/sup 3/ is located at 3 km depth. Calculations indicate the magma body to be solidified and cooled down to temperatures of about or less than 600/sup 0/C (postmagmatic stage). The geothermal energy resources are calculated to be 3.1 x 10/sup 12/ J/km/sup 2/. With 107 refs., 2 tabs., 31 figs.

45273 **(LA—11066-MS-Vol.I) Review of international geothermal activities and assessment of US industry opportunities: Final report.** (Meridian Corp., Alexandria, VA (USA)). Aug 1987. Contract W-7405-ENG-36. 234p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87014018.

This study was initiated to review and assess international developments in the geothermal energy field and to define business opportunities for the US geothermal industry. The report establishes data bases on the status of worldwide geothermal development and the competitiveness of US industry. Other factors identified include existing legislation, tax incentives, and government institutions or agencies and private sector organizations that promote geothermal exports. Based on the initial search of 177 countries and geographic entities, 71 countries and areas were selected as the most likely targets for the expansion of the geothermal industry internationally. The study then determined to what extent their geothermal resource had been developed, what countries had aided or participated in this development, and what plans existed for future development. Data on the energy, economic, and financial situations were gathered.

45274 **(LA—11066-MS-Vol.II) Review of international geothermal activities and assessment of US industry opportunities: Summary report.** (Meridian Corp., Alexandria, VA (USA); Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014019.

This report summarizes a study initiated to review and assess international developments in the geothermal energy field and to define business opportunities for the US geothermal industry. The report establishes data bases on the status of worldwide geothermal development and the competitiveness of US industry. Other factors identified include existing legislation, tax incentives, and government institutions or agencies and private sector organizations that promote geothermal exports. Based on the initial search of 177 countries and geographic entities, 71 countries and areas were selected as the most likely targets for the expansion of the geothermal industry internationally. The study then determined to what extent their geothermal resource had been developed, what countries had aided or participated in this development, and what plans existed for future development. Data on the energy, economic, and financial situations were gathered.

1502 Geology And Hydrology Of Geothermal Systems

45275 **(GPB—7269) Investigation of the geothermal potential of the UK: diagenetic influences on the aquifer properties of the Sherwood Sandstone in the Wessex Basin.** Milodowski, A.E.; Strong, G.E.; Wilson, K.S. (British Geological Survey, Keyworth). 1986. 100p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

In the Wessex Basin, the Sherwood Sandstone Group is a potential reservoir for geothermal energy as well as being a hydrocarbon reservoir. The sandstone is characterised by thin, coarse-grained layers with permeabilities of up to 5 or 6 darcys and porosities of about 25 per cent. The occurrence of these zones is a consequence of the initial grain-size of the sandstone and its diagentic history. Early cementation of significant parts of the sandstone sequence, by carbonates and anhydrite, preserved the rock fabric when it was buried subsequently to greater depths by younger sediments. Of the two cements, the anhydrite was the most significant from the point of view of reservoir properties, for its subsequent dissolution regenerated the original primary porosity and permeability. This was enhanced by the solution of potassium feldspars. From the point of view of developing geothermal resources, the most favourable areas are south of the Mere Fault and, in particular, in the Dorest Basin between the Cranborne Fault and the Purbeck-Isle of Wight faults.

45276 **(LA-UR—87-1779) Geology of Platanares geothermal area, Copan, Honduras.** Heiken, G.; Duffield, W.; Wohletz, K.; Priest, S.; Ramos, N.; Flores, W.; Eppler, D.; Ritchie, A.; Escobar, C. (Los Alamos National Lab., NM (USA); Geological Survey, Flagstaff, AZ (USA); Empresa Nacional de Energia Electrica, Tegucigalpa (Honduras); Charleston Coll., SC (USA)). May 1987. Contract W-7405-ENG-36. 5p. (CONF-871024—1). NTIS, PC A02. File Number DE87010134.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The Platanares, Copan (Honduras) geothermal area is located in a highly faulted terrain of Paleozoic(?) metamorphic rocks, Cretaceous clastic sedimentary rocks, and Tertiary volcanic rocks. All thermal manifestations are located along faults. The volcanic rocks are probably too old to represent the surface expression of an active crustal magma body. Thus, the thermal water is interpreted to be heated during deep circulation in a regime of elevated heat flow. The water chemistry suggests that the geothermal reservoir originates within the Cretaceous sedimentary sequence and that the reservoir temperature may be as high as 240° C. Two exploration coreholes penetrated the volcanic sequence and bottomed within Cretaceous redbeds. Well PLTG-1 is 650 m deep and flows at 3 Mw thermal from a 160° C permeable zone. Well PLTG-2 is 401 m deep and has a thermal gradient of 139° C/km. Exploration drilling is continuing, with a third corehole to be drilled in May, 1987.

45277 **(LA-UR—87-1950) A tracer-based model for heat transfer in a hot dry rock reservoir.** Robinson, B.A.; Jones, G.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 17p. (CONF-871024—9). NTIS, PC A02. File Number DE87011784.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

A model for heat transfer in a Hot Dry Rock (HDR) geothermal reservoir is developed which predicts produced fluid thermal performance based on the tracer-determined residence time distribution and an estimated value of fracture porosity. The tracer response is modeled as flow through several paths of highly fractured rock. Fracture porosity is used to convert fluid volumes to rock volumes, which is necessary to model the heat sweep. The produced fluid response is the mixing cup average of the individual path temperatures. The model adequately represents the measured thermal response of an HDR reservoir operated at the Fenton Hill NM HDR geothermal site in the late 1970's. Application to the current Fenton Hill reservoir predicts a rapid initial thermal drawdown of about 50°C, followed by a very slow thermal decline thereafter. The model is most sensitive to fracture porosity, and less so to the flow path geometry used to match the tracer response.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 45290, 46332, 46335

45278 **(EPRI-AP—5315) Radon as an in situ tracer in geothermal reservoirs: Final report.** Kruger, P.; Semprini, L. (Stanford Univ., CA (USA). Dept. of Civil Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 169p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920551.

Radon is a useful in-situ tracer for examining geologic and thermodynamic properties of geothermal reservoirs. Emanation of radon from radium-bearing rock to pore fluid depends on radium content, rock type, and fluid density. The chemical inertness of radon maintains conservation to the wellhead and its 3.83-day halflife allows sensitive measurement at natural concentrations. Field experiments at two-phase geothermal resources have shown that wellhead radon concentration correlates with specific volume of the pore fluid in the reservoir, responding rapidly to changes in reservoir fluid enthalpy. This report includes a data base, analysis and interpretation. The data showed significant variations with time reflecting the effects of local boiling in changing the steam fraction around wellbores in two-phase reservoirs. Steady-state and transient models were used to examine separate flows of steam and water phases with separate phase mobilities and radon partitioning between the two phases. Monitoring of radon, especially at two-phase and vapor-dominated reservoirs should prove useful in interpreting any observed changes in the thermodynamic behavior of producing geothermal resources.

45279 **(EUR—10019-DE) Bruchsal geothermal project. Seismic reflection surveys and their interpretation in view of the Bruchsal 1 and 2 geothermal drilling works.** (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 70p. (In German). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The Bruchsal research project was dedicated to the recovery of geothermal energy from thermal deepwaters. The tectonically complicated research conditions (plains of the upper Rhine region near the county town of Bruchsal) necessitated extensive seismic surveys to precede the determination of drilling locations and the planning of drilling works as such. The geothermal exploration of the structure of potential shell marl or new red sandstone aquifers was based on the evaluation of different seismic profiles and their Tertiary and Mesozoic seismic reflections. The expected deepnesses of shell marl and new red sandstone were about 2500 m. Temperatures were between 100 and 125/sup 0/C. Pumping tests were designed for hauling capacities of 10.5 l/s. The pressure drop at a depth of 2235 m was indicative of yields above 20 l/s. (HWJ).

45280 **(LA-UR—87-1874) Geothermal corehole drilling and operations, Platanares, Honduras, Central America.** Goff, S.; Rufenacht, H.D.; Laughlin, A.W.; Adams, A.; Planner, H.; Ramos, N. (Los Alamos National Lab., NM (USA); Swissboring Ltd., Guatemala City (Guatemala); Empresa Nacional de Energia Electrica, Tegucigalpa (Honduras)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871024—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011792.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

Two slim exploration coreholes to depths of 650 m and 428 m, respectively, have been completed at the Platanares geothermal site, Honduras, Central America. A third corehole is now being drilled. These boreholes have provided information on the stratigraphy, temperature variation with depth, nature and compositions of fluids, fracturing, permeability, and hydrothermal alterations associated with the geothermal reservoir. Eruptions of hot water occurred during the drilling of both the first and third boreholes. Recovery of >98% core has been obtained even under difficult superheated conditions.

45281 **(LA-UR—87-1918) Chemical and isotopic characteristics of thermal fluids in the Long Valley caldera lateral flow system, California.** Shevenell, L.; Goff, F.; Grigsby, C.O.; Janik, C.J.; Trujillo, P.E. Jr.; Counce, D. (Los Alamos National Lab., NM (USA); Geological Survey, Menlo Park, CA (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871024—4). NTIS, PC A02. File Number DE87011788.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

Chemical and isotopic data of thermal waters in Long Valley caldera have been used to identify both the origins and characteristics of the fluids and to evaluate mixing and boiling processes occurring within the lateral flow system of the caldera. Recharge to the Long Valley geothermal system occurs in the western part of the caldera with the water being heated at depth and flowing laterally eastward in the subsurface. The lateral flow system was recently intersected by the Shady Rest Continental Scientific Drilling Program (CSDP) corehole at 335 m (1100 ft) with fluids in this 202°C zone being more concentrated than non-boiled fluids to the east. As the Na-K-HCO_3-Cl thermal fluids flow eastward, they are increasingly mixed with isotopically depleted, dilute groundwaters similar to cold waters east of Lake Crowley. Near surface boiling of Casa Diablo well fluids at 100°C forms waters with the compositions of Colton and Casa Diablo hot springs. Waters to the east of the Casa Diablo area are mixtures of meteoric water and boiled thermal fluids with a composition close to that of Colton Hot Spring. There is no correlation between ^{3}H and ^{36}Cl in thermal fluids or between these components and conservative species, and it appears that cold fluids involved in mixing must be relatively old waters, low in both meteoric ^{3}H and ^{36}Cl.

45282 **(LA-UR—87-1919) Stratigraphy, temperature profiles, and flow test data from the PLTG-1 and PLTG-2 coreholes, platanares geothermal system, Honduras.** Goff, F.; Shevenell, L.; Kelkar, S.; Smith, D.; Meert, J.; Heiken, G.; Bargar, K.; Ramos, N.; Truesdell, A.H.; Stallard, M.. (Los Alamos National Lab., NM (USA); Florida Univ., Gainesville (USA). Dept. of Geology; Geological Survey, Menlo Park, CA (USA); Empresa Nacional de Energia Electrica, Tegucigalpa (Honduras)). 1987. Contract W-7405-ENG-36. 9p. (CONF-871024—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011787.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

Stratigraphy, temperature profiles, and flow test data from the PLTG-1 and PLTG-2 coreholes in Platanares, Honduras, have been used to determine production characteristics from a 160°C fluid zone at 625 to 640 m depth and to estimate depth to the source geothermal reservoir. The two coreholes penetrate thin Quaternary deposits and several hundred meters of Miocene volcanics and Cretaceous to Eocene sedimentary rocks. Extrapolation of the deep thermal gradient of 139°C/km in PLTG-2 (depth 401 m) indicates the source reservoir of 220 to 240°C fluid occurs at 1.2 to 1.5 km depth. Flow tests of PLTG-1 from the 625 to 640 m zone show that 160°C geothermal fluids similar in composition to "end-member" hot springs originate from fractured meta-conglomerates of the Valle de Angeles Group. Pressure transient analysis indicates this flow zone taps a localized reservoir having a volume on the order of 0.065 km^3. Maximum thermal power of PLTG-1 is roughly 3 MW/sub t/. Scaling of aragonite results from flashing of the dilute, high pH, high HCO_3 fluid. Use of the shallow, 160°C resource will require binary cycle power plants and, possibly, downhole pumps to successfully extract heat from the fluids for electrical applications.

45283 **(LA-UR—87-2006) Vapor mass ratio measurements in geothermal production wells.** Dennis, B.R.; Kolar, J.D.; Lawton, R.G. (Los Alamos National Lab., NM (USA); Lawton and Associates, Santa Fe, NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-871024—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011774.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

Measurements in geothermal wellbores are very difficult because of the high-fluid pressures, high borehole temperatures, and limited data transmission links. Here the extraneous effects on transducers and associated signal conditioning are very difficult to eliminate and if not carefully controlled may be the only variables measured. All the effects of these severe environments are not found in textbooks but come primarily through experience. Calibration of all transducers and instruments under simulated environmental conditions is absolutely essential. All materials and equipment used in the instrumentation systems must be carefully chose, well understood and properly used. The time and effort spent in good planning and preparation will greatly increase the probability of meaningful data processing and prove to be much more efficient. The applications of conscientious calibration methodology together with applicable data analysis can result in very meaningful information concerning fluid flow in geothermal wells. Recently a number of geothermal production wells were logged using a high-temperature spinner/temperature/pressure (STP) tool developed under the Hot Dry Rock Geothermal Energy Program. To determine the thermodynamics state of the flowing wellbore fluid when the fluid can be in both the liquid and/or vapor state, absolute values of temperature and pressure are necessary. Consider, for example, the analysis of data obtained from one particular well, PGM-10, where the fluid flow was reported to be 21 kg/sec and the fluid temperatures at the surface was 240°C.

45284 **(LA-UR—87-2113) Applications of a downhole programmable microprocessor for a geothermal borehole inspection tool.** Jermance, R.L.; Moore, T.K.; Archuleta, J.; Hinz, K. (Los Alamos National Lab., NM (USA); Mechanical Design Services, Santa Cruz, NM (USA); Westfaelische Berggewerkschaftskasse, Bochum (Germany, F.R.). Inst. fuer Geophysik). 1987. Contract W-7405-ENG-36. 7p. (CONF-871024—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011754.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The high-temperature scanning borehole inspection system is currently being developed jointly by the Los Alamos National Laboratory (LANL) and Westfalische Berggewerkschaftskasse (WBK) of West Germany. The downhole instrument is a digital televiewer that utilized a microprocessor to digitize, process and transmit the acoustic information to the surface acquisition and control system. The primary operation of the downhole acoustic assembly uses a piezoelectric crystal acting as a receiver-transmitter which is mounted on the rotating head. The crystal emits a burst of acoustic energy that propagates through the borehole fluid with a portion of the energy reflected by the borehole wall back to the crystal. The time of travel and the amplitude of the reflected signal are conditioned by the microprocessor and transmitted along with other pertinent data to the surface data processing center. This instrument has been designed specifically for use in geothermal borehole environments to determine the location of fractures intersecting the borehole and provide information concerning overall borehole conditions. It may also be used for definitive casing inspection. The in-

strument essentially eliminates operator interaction for downhole control and simplifies assembly and maintenance procedures.

45285 (LBL—23648) Gravity and fault structures, Long Valley caldera, California. Carle, S.F.; Goldstein, N.E. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 9p. (CONF-871024—15). NTIS, PC A02. File Number DE87014117.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The main and catastrophic phase of eruption in Long Valley occurred 0.73 m.y. ago with the eruption of over 600 km^3 of rhyolitic magma. Subsequent collapse of the roof rocks produced a caldera which is now elliptical in shape, 32 km east-west by 17 km north-south. The caldera, like other large Quarternary silicic ash-flow volcanoes that have been studied by various workers, has a nearly coincident Bouguer gravity low. Earlier interpretations of the gravity anomaly have attributed the entire anomaly to lower density rocks filling the collapsed structure. However, on the basis of many additional gravity stations and supporting subsurface data from several new holes, a much more complex and accurate picture has emerged of caldera structure. From a three-dimensional inversion of the residual Bouguer gravity data we can resolve discontinuities that seem to correlate with extensions of pre-caldera faults into the caldera and faults associated with the ring fracture. Some of these faults are believed related to the present-day hydrothermal upflow zone and the zone of youngest volcanic activity within the caldera.

45286 (SAND—87-1571C) Test of the radar fracture mapping tool in a lake using a known target. Duda, L.E.; Chang, Hsi-Tien; Uhl, J.E.; Gabaldon, J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871024—11). NTIS, PC A02. File Number DE87012369.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

A method to locate fractures adjacent to but not intersecting a wellbore would be a great aid to the geothermal industry. A prototype downhole radar probe was recently completed with the aim of locating fractures near a single wellbore. This probe, operating in the pulse mode with a bandwidth of 30 to 300 MHz, contains two identical directional antennas. As with any prototype instrumentation, extensive field work is required to completely understand the characteristics of the system. A first step in that understanding is to operate the instrument under known or controlled conditions. In this paper, a series of tests of the radar probe in a lake using a known target are reported. In the tests, signals reflected from the target were observed when the target was 5 ft and 9 ft from the probe; in the latter case the returned signal was greatly attenuated by the water. The measured 3 dB beamwidth of the system to the target was 70 degrees. Finally, the effect of target size was studied by moving the probe across the face of the target.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 45273, 45274

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 44981, 45279, 46337

45287 (LA-UR—87-2082) Identification of MHF [massive hydraulic fracturing] fracture planes and flow paths: A correlation of well log data with patterns in locations of induced seismicity. Dreesen, D.; Malzahn, M.; Fehler, M.; Dash, Z. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-871024—8). NTIS, PC A02. File Number DE87011765.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

One of the critical steps in developing a hot dry rock geothermal system is the creation of flow paths through the rock between two wellbores. To date, circulation systems have only been created by drilling one wellbore, hydraulically fracturing the well (which induces microearthquakes), locating the microearthquakes and then drilling a second wellbore through the zone of seismicity. A technique for analyzing the pattern of seismicity to determine where fracture planes are located in the seismically active region has recently been developed. This allows us to distinguish portions of the seismically active volume which are most likely to contain significant flow paths. We applied this technique to seismic data collected during a massive hydraulic fracturing (MHF) treatment and found that the fracture planes determined by the seismic method are confirmed by borehole temperature and caliper logs which indicate where permeable fractures and/or zones of weakness intersect the wellbores. A geometric model based on these planes and well log data has enhanced our understanding of the reservoir flow paths created by fracturing and is consistent with results obtained during production testing of the reservoir.

45288 (LA-UR—87-2083) Developing hot dry rock reservoirs with inflatable open hole packers. Dreesen, D.S.; Miller, J.R.; Nicholson, R.W. (Los Alamos National Lab., NM (USA); Well Production Testing, Boulder City, NV (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871024—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011764.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

An open hole packer system was designed for high pressure injection operations in high temperature wells at the Fenton Hill, Hot Dry Rock (HDR) Geothermal Site. The packer runs were required to verify that the HDR reservoir fractures had been penetrated during the drilling of well EE-3A. They were also used to stimulate fractures connecting EE-3A to the reservoir and to conduct two massive hydraulic fracture treatments at the bottom of EE-3A. An attempt to use a modified packer design as a temporary well completion system was not successful but with modification the system may prove to be an important HDR completion technique. The eleven packer runs have demonstrated that formation testing, stimulation and HDR reservoir development can now be conducted with an open hole inflatable packer operating over large temperature ranges and high differential pressures.

45289 (LA-UR—87-2114) Redrilling of well EE-3 at the Los Alamos National Laboratory HDR [Hot Dry Rock] project. Schillo, J.C.; Nicholson, R.W.; Hendron, R.H.; Thomson, J.C. (Los Alamos National Lab., NM (USA); Well Production Testing, Boulder City, NV (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871024—2). NTIS, PC A02. File Number DE87011753.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The successful sidetracking of well EE-3 and the drilling of well EE-3A proved that with detailed planning and by adjusting techniques based on previous experience at Fenton Hill, drilling can be accomplished with reduced risk. The primary drilling problems associated with drilling of hot, crystalline basement rock, are (a) abrasiveness between the downhole tools and the formations and (b) a crooked wellbore path. These were essentially eliminated by a specially designed drilling fluid and careful pre-planning of the directional drilling operations. These improvements have taken much of the risk out of drilling at the Fenton Hill Hot Dry Rock (HDR) Geothermal Test Site. The sidetracking of EE-3 and drilling of EE-3A were undertaken to complete the hydraulic connection between boreholes. Drilling through fractured regions indicated by the dense zones of microseismic activity increased the probability of success. EE-3 was sidetracked at 9373' and redrilled to a depth of 13,182'.

45290 (LBL—23608) The geothermal program at Lawrence Berkeley Laboratory. Lippmann, M.J. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 8p. (CONF-871024—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012884.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The main purpose of the geothermal program at Lawrence Berkeley Laboratory is to develop, improve and validate methods and instrumentation to: (1) determine geothermal reservoir param-

eters; (2) detect and characterize reservoir fractures and boundaries; and (3) identify and evaluate the importance of reservoir processes. The ultimate objective of the program, which includes field, theoretical and modeling activities, is to advance the state-of-the-art for characterizing geothermal systems and evaluating their productive capacity and longevity under commercial exploitation.

45291 **(SAND—87-1572C) Investigation of wellbore cooling by circulation and fluid penetration into the formation using a wellbore thermal simulator computer code.** Duda, L.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871024—10). NTIS, PC A02. File Number DE87012015.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

The high temperatures of geothermal wells present severe problems for drilling, logging, and developing these reservoirs. Cooling the wellbore is perhaps the most common method to solve these problems. However, it is usually not clear what may be the most effective wellbore cooling mechanism for a given well. In this paper, wellbore cooling by the use of circulation or by fluid injection into the surrounding rock is investigated using a wellbore thermal simulator computer code. Short circulation times offer no prolonged cooling of the wellbore, but long circulation times (greater than ten or twenty days) greatly reduce the warming rate after shut-in. The dependence of the warming rate on the penetration distance of cooler temperatures into the rock formation (as by fluid injection) is investigated. Penetration distances of greater than 0.6 m appear to offer a substantial reduction in the warming rate. Several plots are shown which demonstrate these effects.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 46338

45292 **(DOE/SF/15548—T11) Two-phase flow in geothermal systems: Final report, July 15, 1986-April 30, 1987.** Maeder, P.F.; Kestin, J. (Brown Univ., Providence, RI (USA)). Aug 1987. Contract AC03-85SF15548. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014024.

The object was to establish a full experimental correlation between flashing flows of water-steam in actual geothermal wells and flashing flows of refrigerant-114 (R-114) in the Brown University/DOE Two-Phase Flow Facility. Our experiments show that the similarity theory developed in our laboratory during previous phases of this research project can be used to predict accurately the pressure gradient in the two-phase region of a flowing geothermal well using laboratory measurements on R-114. This holds even when the actual geothermal well contains significant amounts of noncondensable gases. In this case, however, corrections must be introduced to account for the partial pressure of the gases.

45293 **(DOE/SF/15548—T12) Theoretical and empirical study of single-substance, upward two-phase flow in a constant-diameter adiabatic pipe.** Laoulache, R.N.; Maeder, P.F.; DiPippo, R. (Brown Univ., Providence, RI (USA). Div. of Engineering). May 1987. Contract AC03-85SF15548. 216p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87014028.

A scheme is developed to describe the upward flow of a two-phase mixture of a single substance in a vertical adiabatic constant area pipe. The scheme is based on dividing the mixture into a homogeneous core surrounded by a liquid film. This core may be a mixture of bubbles in a contiguous liquid phase, or a mixture of droplets in a contiguous vapor phase. The core is turbulent, whereas the liquid film may be laminar or turbulent. The working fluid is Dichlorotetrafluoroethane $CClF_2$-$CClF_2$ known as refrigerant 114 (R-114); the two-phase mixture is generated from the single phase substance by the process of flashing. In this study, the effect of the Froude and Reynolds numbers on the liquid film characteristics is examined. An expression for an interfacial friction coefficient between the turbulent core and the liquid film is developed; it is similar to Darcy's friction coefficient for a single phase flow in a rough pipe. Results indicate that for the range of Reynolds and Froude numbers considered, the liquid film is likely to be turbulent rather than laminar. The study also shows that two-dimensional effects are important, and the flow is never fully developed either in the film or the core. In addition, the new approach for the turbulent film is capable of predicting a local net flow rate that may be upward, downward, stationary, or stalled. An actual steam-water geothermal well is simulated. A similarity theory is used to predict the steam-water mixture pressure and temperature starting with laboratory measurements on the flow of R-114. Results indicate that the theory can be used to predict the pressure gradient in the two-phase region based on laboratory measurements.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

45294 **(ETSU-STP—4036) Steel caissons for the Severn Barrage.** Mackie, G.C.; Rowan, R.P. (Energy Technology Support Unit, Harwell (UK); Y-ARD Ltd., Glasgow (UK); Roxburgh and Partners, Glasgow (UK)). 1 Jun 1984. vp. (YM—4223; Y—2622). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The YARD/Roxburgh study concludes that the construction, installation and maintenance of steel caissons for the Severn Barrage is technically feasible. Corrosion protection systems are available which would provide a 120 year life comparable with that of concrete. The cost of the steel work option shows a significant potential saving compared with the use of concrete. Existing shipyard facilities combined with one oil platform construction yard could provide the necessary construction facilities for the turbine caissons. The smaller sluice caissons could be built by several shipyards and offshore construction yards. The cost studies specifically exclude any assessment of the social and industrial value of the steelwork option to the United Kingdom's steel and shipbuilding industries.

1608 Wave Energy Converters

45295 **(ETSU-WV—1672/P2) Design study with experimental support on a reactionless wave energy converter buoy (FROG).** French, M.J.; Bracewell, R.H. (Energy Technology Support Unit, Harwell (UK)). 1987. 16p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A progress report is given on research into the wave power device known as a pitching/surging 'FROG'. Hydrodynamic coefficients were measured for small models and were in agreement with calculations. It is claimed that the device would have a much higher load factor than other wave converters and consequently would be considerably cheaper than previous UK estimates.

17 WIND ENERGY

REFER ALSO TO CITATION(S) 45226, 45227, 45550

1701 Availability (climatology)

45296 **(BMFT-FB-T—86-169) Wind measuring of high altitudes. Final report.** Tetzlaff, G.; Theunert, S.; Hoff, A.; Ruhe, W.; Trapp, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Hamburgische Electricitaets-Werke A.G. (Germany, F.R.); Hannover Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimatologie). Dec 1986. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87770257.

A meteorological tower was erected by 'Hamburgische Electricitaets-Werke', located in the area of Kaiser-Wilhelm-Koog. The meteorological data were evaluated by the Institute for Meteorology and Climatology of the University of Hannover. In the period from October 1980 to December 1983 the wind velocity, the wind direction and the air temperature were recorded as 2-minute-average-values in heights of 10 m, 50 m, 100 m and 150 m. The measuring period represented a normal period with all seasons like one can see from the studies of the geostrophical wind. The verti-

cal wind profile was covered by calculation and measurement. The average values of the wind velocities are in the range of former measurements and calculations with an annual average value of 7,4 m/s in a height of 50 m. The measured results confirm the wind data assumed for the location of Growian. With 33 refs., 21 tabs., 43 figs.

45297 **(ETSU-WN—0561/2) Offshore wind-energy resource around the United Kingdom.** White, P.A. (Department of Energy, London (UK). Energy Efficiency Office). Oct 1983. 88p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

An attempt has been made to assess the offshore wind-energy resource available around the United Kingdom. The variations of the resource are presented on a geographic, seasonal and annual basis. Data for the twenty-year period 1961-1980 have been used for this study, and the geographic area considered is divided into one-degree squares. The main results of the study are presented in graphical and tabular form. The procedures adopted to obtain the results are outlined and notes are given on the variation of wind speed with height and the geographical correlation of wind speeds. Appendices describe briefly the data sets created for this study, and give an example of the way in which the results might be used.

1703 Regulations

45298 **(NEI-DK—37) Recommendation for an administrative procedure for certification and licensing of wind turbines.** Harvoee, P.; Hjuler Jensen, P. (eds.). (Risoe National Lab., Roskilde (Denmark)). Oct 1986. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752860.

The lack of existing rules concerning the setting up of wind turbines makes it possible to establish common standards and certification rules for wind turbines in the whole EEC market. Free trade within EEC is necessary if a European wind turbine industry is to enjoy a fair share of the large global market which is anticipated. The report suggests the setting up of national test stations for certifying wind tubines in the EEC-countries and by cooperation between these test centres to create common certification rules. A draft for this procedure is given.

1704 Economics

REFER ALSO TO CITATION(S) 45298

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 45296, 45533

45299 **(DOE/NASA—3277-4) Performance and aerodynamic braking of a horizontal-axis wind turbine from small-scale wind tunnel tests.** Cao, H.V.; Wentz, W.H. Jr. (Wichita State Univ., KS (USA)). Jul 1987. Contract AI01-76ET20320. 43p. (NASA-CR—180812). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014297.

Wind tunnel tests of three 20-inch diameter, zero-twist, zero-pitch wind turbine rotor models have been conducted in the WSU 7' x 10' wind tunnel to determine the performance of such rotors with NACA 23024 and NACA 64_3-621 airfoil sections. Aerodynamic braking characteristics of a 38 percent span, 30 percent chord, vented aileron configuration were measured on the NACA 23024 rotor. Surface flow patterns were observed using fluorescent mini-tufts attached to the suction side of the rotor blades. Experimental results with and without ailerons are compared to predictions using airfoil section data and a momentum performance code. Results of the performance studies show that the 64_3-621 rotor produces higher peak power than the 23024 rotor for a given rotor speed. Analytical studies, however, indicate that the 23024 should produce higher power. Transition strip experiments show that the 23024 rotor is much more sensitive to roughness than the 64_3-621 rotor. These trends agree with analytical predictions. Results of the aileron tests show that this aileron, when deflected, produces a braking torque at all tip-speed ratios. In free-wheeling coastdowns the rotor blade stopped, then rotated backward at a tip-speed ratio of -0.6. Results of the tuft studies indicate that substantial spanwise flow develops as blade stall occurs at low tip-speed ratios.

45300 **(ETSU-WN—5003/1) Measurement of velocity and turbulence profiles in flow situations relevant to wind turbine performance.** Green, D.R.R.; Alexander, A.J. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). May 1985. 152p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

To provide power on a national scale, a large number of windmills will have to be deployed in wind farms or arrays because the output of individual machines is relatively small. Within an array, some windmills will be faced with the wakes generated by others. This interaction leads to a loss of power relative to upwind turbines and changes in the wind loading across the turbine blades. In the absence of any large arrays of wind turbines, the power generating utilities are faced with problems of how to site machines, and the unknown consequences of wake interaction upon machine integrity. The problems of modelling wind turbines and their wakes are examined, at a scale well beyond conventional fluid dynamic scaling limits; and the features of model turbine wakes are investigated from a predominantly experimental view.

45301 **(ETSU-WN—5017/1) Report on the monitoring system for the Wind Energy Group MS1 wind turbine generator at Burgar Hill, Orkney.** Haines, R.S. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Dec 1985. 80p. (WEG-M—4068). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The hardware and software of a monitoring system configured to monitor the WEG MS1 250kW wind turbine generator at Burgar Hill are described. The system comprises a data handling system based on two mini-computers with peripherals, a data acquisition system using Pulse Code Modulation and incorporating two PCM tape recorders, and over 200 sensors, about 100 separate signals normally being monitored at the same time. The sensors include sensors on the WTG mechanical elements, relays and buffers at its controller, and anemometrical sensors.

45302 **(ETSU-WN—5028/1) Modal survey of the WEG MS-1 wind turbine on Burgar Hill.** Garrad, A.D. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.; Taylor Woodrow Construction Ltd., Southall (UK)). Dec 1984. 157p. (TWC-P—1179). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The experimental equipment and procedure for the isolated rotor and complete system modal surveys of the WEG MS-1 turbine are described. Mode shape and frequency data are presented both in tabular and graphical form for both surveys. In the case of the survey of the complete system data are presented for four configurations - made up from the combinations of rotor position and hub restraint. Each mode is discussed in detail and compared, where applicable, to the equivalent mode predicted by a finite element model. It is demonstrated that very good agreement is obtained for the blade modes but that the agreement is less good for the coupled tower-rotor modes. The point of excitation is shown to have a powerful effect on the resonant frequencies of the system and the non-linear nature of the teeter restraint is shown to influence the system resonances quite strongly.

45303 **(ETSU-WN—5035) Dynamics of vertical axis wind turbines - wind tunnel testing.** Done, G.T.S.; Courtney, M.S. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). Apr 1986. 39p. (MED—156). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The design, construction, instrumentation and associated data analysis of an H-configuration vertical axis wind tunnel model are described. Dynamic tests, concerned mainly with identifying natural frequencies and growth or decay rates are also described. These tests were carried out with the wind turbine model rotating

in still air and in moving air i.e. in the wind tunnel. The results are compared with those obtained theoretically.

45304 **(ETSU-WN—5040/1) Near wake wind tunnel studies.** Green, D.R.R. (UKAEA Atomic Energy Research Establishment, Harwell. Energy Technology Div.). 1987. 54p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

As the prospects for the construction of large wind turbine arrays draw closer, the need to investigate specific interactions between machines has grown. Attention is now directed towards the accurate prediction of the increased aerodynamic loading of turbine blades resulting from submersion in a turbulent upstream wake flow. Turbulence in a scale model wind turbine cluster has been examined in terms of its ability to influence turbine rotor loading. The structure of the wake turbulence is then investigated in detail using two different techniques, to provide a detailed description of the turbulence. It is concluded that while the wake turbulence is significantly non-Gaussian, the intensity of the turbulence is an adequate measure of the flow for loading analysis, though questions are raised concerning the length and time scales. The effect upon the quality of the power generated by a turbine subjected to this turbulence is then investigated.

45305 **(SAND—87-1093C) Results of a wind turbine/sealed lead-acid battery experiment.** Freese, J.M.; Butler, P.C.; Cowan, R.A. (Sandia National Labs., Albuquerque, NM (USA); On Site Energy, Portland, OR (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-871027—30). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012720.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

A coupled, stand-alone wind turbine generator/battery storage system has been evaluated by Sandia National Laboratories (SNL). The goal was to evaluate advanced batteries in solar applications. This paper addresses the system components, instrumentation, operation, and some of the results obtained during this evaluation. This system evaluation demonstrated that advanced lead-acid batteries can be successfully used with wind turbines to reliably satisfy an actual energy demand.

45306 **(SSSU—25) Need for windship research in Europe.** Satchwell, C.J. (Southampton Univ. (UK). Dept. of Ship Science). Jul 1986. 9p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The area of European economic activity associated with wind-assisted propulsion for ships is examined. Wind-assist devices are now being produced as prototypes in at least three European countries and are already well-established products in Japan. It is suggested that the CEC consider taking an interest in this field, with a view to improving the position of the European manufacturing and shipping industries.

45307 **Verification of theoretically computed spectra for a point rotating in a vertical plane.** Powell, D.C.; Connell, J.R. (Pacific Northwest Lab., Richland, WA). *Solar Energy;* **39**: No. 1, 53-63(1987). Contract AC06-76RL01830.

The ability to generate a model turbulent wind as it is seen by a rotating blade, independent of measurement, is important in wind turbine design and testing. A theoretical model of the spectrum of rotationally sampled wind speed developed at the Pacific Northwest Laboratory is tested against corresponding measured wind spectra. The measured spectra were selected from a number of cases measured with a vertical plane array of anemometers. The array was set up to correspond to the tip circle of a nearby MOD-OA wind turbine rotor blade. For purposes of testing and of illuminating the process, the turbulence and mean wind shear were treated separately. In each case the test was based on two criteria, each involving comparison of results from the theoretical model and results from real data analysis. These criteria were the rotational spectra and the integration of the spectra within each harmonic band into energy. Particularly the latter criterion was used. The measured spectra were selected to represent different atmospheric stability conditions. The theory is shown to achieve respectable accuracy readily except when applied to the stable atmosphere case. Recommendations are made for selection of the values of atmospheric parameters to be used for computing the theoretical result. The importance of the length of time of a measured turbulence record that is to be used in estimating several parameters for input to the theoretical model applied to real wind conditions at a selected turbine site is discussed. The VAX 11/780 computer time required to generate a mode spectrum is usually less than one minute.

20 ELECTRIC POWER ENGINEERING

45308 **(EY—86006) Energy analysis. Second CRIEPI-EPRI workshop.** Uchida, M.; Smith, W.M.; Yamaji, K. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1987. 251p. (CONF-8609322—Pt.1). CRIEPI, 1-6-1 Otemachi, Chiyoda-ku, Tokyo 100, Japan .

From 2. CRIEPI-EPRI workshop on energy analysis; Tokyo, Japan (24 Sep 1986).

The papers presented at the second CRIEPI-EPRI workshop on Energy Analysis covered three main areas. Demand-side issues were examined including aspects of management, analyses of time-of-use rates for electricity and applications of models. Supply-side analysis is the second topic covered, involving a look at utilities with regard to management and analysis with different models. The third topic covered is end-use modelling where utilities response to the process model approach is analysed.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 44891, 44959, 45519, 45560, 45588, 45688

45309 **(CRIEPI—285091) Water-cooled gas turbine blade (Part 1).** Ono, Y. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). 1986. vp. (In Japanese). Central Research Institute of Electric Power Industry.

CRIEPI proposed a New Water Cooled Bucket technique which installs an inner tube in the cooling passage of Schmidt's blade inlet flow. The technique of Water Cooled Gas Turbine is very important to raise the efficiency of coal gasification gas-steam combined cycle power plants, and to be able to use not very clean fuel. This paper describes the result of an analysis of thermal stress on the P.C.D. section of a model blade which was carried out in order to obtain optimum cooling structure information on the water-cooled bucket proposed by CRIEPI.

45310 **(DOE/METC—87/6077) Proceedings of the annual heat engines and gas stream cleanup systems contractors review meeting.** Byam, J.W. Jr.; Markel, K.E. Jr. (eds.). (EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA); USDOE Morgantown Energy Technology Center, WV). Apr 1987. 494p. (CONF-8704135—). NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE87001072.

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

The Annual Heat Engines and Gas Stream Cleanup Systems Contractors Review Meeting was held on April 21-23, 1987, at the Sheraton Lakeview Conference Center in Morgantown, West Virginia, and was sponsored and hosted by the US Department of Energy (DOE), Office of Fossil Energy, Morgantown Energy Technology Center (METC). This annual meeting provided a forum for the exchange of information between DOE contractors and interested parties, and this year's meeting was attended by 235 individuals from industry, academia, national laboratories, and other Governmental agencies. The overall objective of these programs is the development of technology that is essential for private sector commercialization of integrated heat engine and gas stream cleanup systems which will produce power from coal in a cost competitive and environmentally acceptable manner. This document has been reproduced from camera-ready manuscripts furnished by the authors. The manuscripts have not been refereed, nor have they been extensively edited. Papers have been entered individually into EDB and ERA.

45311 **(EPRI-CS—5264) Acoustic emission monitoring of cracks in fossil fuel boilers: Final report.** Coulter, J.E.; Sherlock, T.P.; Stevens, D.M. (Babcock and Wilcox Co., Lynchburg, VA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1987. 109p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920503.

This report presents the results of acoustic emission (AE) monitoring of a cracked header during hydrostatic testing and the on-line AE monitoring or an operating steam header in a fossil boiler. A retired header containing known cracks was pressurized in the laboratory, and the results of the hydrotest provided a sound technical basis for the subsequent field tests of an operating unit. A secondary superheater outlet header at Pulliam Unit 7 of Wisconsin Public Service was monitored during cold startup, restart, and on-line operating conditions. This header was known to contain cracking in the tube hole ligaments and tube stub weld areas. The results of the field tests demonstrated the technical feasibility of using acoustic emission techniques for monitoring crack growth in boiler pressure components.

45312 **(EPRI-CS—5320) Fossil plant inspections conference: Proceedings.** Singh, G.P. (ed.). (Karta Technology, Inc., San Antonio, TX (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 780p. (CONF-8609330—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920569.

From Fossil plant inspections conference; San Antonio, TX, USA (9 Sep 1986).

Plant inspections play a major role in plant availability and life extension. To explore this thesis, the Fossil Plant Inspections Workshop, sponsored by the Electric Power Research Institute was held in San Antonio, Texas on September 9-11, 1986. Presentations were made about the experiences of utilities, state-of-the-art inspection approaches, factors that require consideration, technical approaches to evaluating remaining life, and methods of extending the useful life of components. Of the more than 240 people attending the workshop, over 60% represented utilities in the US and abroad, and the rest represented architect-engineers, suppliers to the utility industry, and the government agencies and research organizations involved with the industry. During the workshop, presentations were given about utility inspection programs, and about state-of-the art inspection of boiler tubing, header, steam piping, steam turbine, heat exchangers, and condensers. Working group sessions were held so that utility representatives could meet to discuss issues associated with inspection of major plant components such as boilers, steamlines, turbine and generators, etc. Papers have been entered individually with EDB and ERA.

45313 **(EPRI-EL—4958) Dynamic security assessment for power systems: Research plan: Final report.** Kumar, A.B.R.; Amelink, H.; Pang, C.K. (ECC, Inc., San Jose, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 326p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920578.

This is the final report for Research Project 2496-1, "Power System Dynamic Security Assessment: Research Plan." The objectives of the project are to identify how the electric utility industry can assess dynamic security in system operations, to identify analytical techniques required for assessment and enhancement of dynamic security, and to prepare a research and development plan for implementing a dynamic security assessment (DSA) method for daily system operations use. The emphasis in the project is to review available techniques in a comprehensive manner such that no potentially useful method is inadvertently overlooked. Included in this review are industry practices in DSA and existing needs of the power system operator for an on-line DSA system. Based on the results of the review, a comprehensive list of R and D needs is prepared and an R and D plan is proposed to meet the more important of those R and D needs. Because of its thorough literature survey and detailed review of industry practices, this report can also serve as a tutorial on dynamic security assessment. 60 refs., 20 figs.

45314 **(NP—7770267) Time-dependent processes and damage detection in thermal system components. Progress report: Second half of 1983 to first half of 1986.** (Hannover Univ. (Germany, F.R.). Sonderforschungsbereich 211 - Zeitabhaengige Vorgaenge und Schadenserkennung in Komponenten Waermetechnischer Anlagen). Feb 1986. 380p. (In German). NTIS (US Sales Only), PC A17. File Number DE87770267.

The reports on hand are concerned with subprojects of the special research group 211 and cover the period from 1st July, 1983 to 31st December, 1985. The individual papers come under the following project areas: a) Time-dependent processes in heat exchanging devices and pipelines; b) Non-stationary flow-mechanical and structure-mechanical behaviour of turbo-machinery; c) Analysis methods for damage detection in systems and components. In addition, funding and promotion of projects and young scientists are commented on. (HAG).

45315 **Turbine disposition, erosion and corrosion evaluations using a simplified test approach.** Wenglarz, R.A. New York, NY; American Society of Mechanical Engineers (1987). 7p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-214.

New applications and fuels (such as coal) that increase the potential for flow path degradation due to deposition, erosion, and corrosion (DEC) are considered for gas turbines. Cascade and turbine DEC tests representing the flow paths of the specific turbines of concern will eventually be necessary for final verification of fuels and DEC control approaches. However, these tests are expensive and are not readily interpretable for other conditions (e.g., fuels and flow passage variations) than those tested. The most promising alternatives determined from simplified tests could then be verified in more expensive cascade and turbine tests. This paper discusses simplified DEC tests and complementary data extrapolation approaches that provide and interpret data in a manner that enhances understanding of DEC processes and that can be used to estimate DEC in operating turbines. A new test facility that has been designed for relatively inexpensive turbine DEC evaluations using these approaches is described.

45316 **Development of coal-fueled gas turbine systems for electric utility application.** Thoman, R.J.; Horazak, D.A.; Hals, F.A. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-271.

The authors' companies are working to establish the technology base for an advanced direct coal-fired gas turbine system. This work, sponsored by the Department of Energy, is directed at the electric utility application. This paper describes the technical approach and discusses its feasibility. Successful development of a slagging combustor is key to this effort. Integrated testing incorporates the subscale slagging combustor and a small gas turbine into an operating electric generating system. In addition, a utility-sized combustor module is designed and tested under utility operating conditions.

45317 **Combustion and deposition in coal-fired turbines.** Kimura, S.G.; Spiro, C.C.; Chen, C.C. New York, NY; American Society of Mechanical Engineers (1987). 7p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-266.

Combustion and deposition behavior of coal in the form of highly beneficiated coal-water mixtures (CWM) is investigated. The solids content of the CWM fuels was typically 50%, with a mean coal particle size of 4 microns and an ash content of 0.8% (dry). Combustion efficiencies in excess of 99.5% based on the carbon

content of the collected ash were achieved in gas turbine-type can combustors with residence times of less than 20 milliseconds with up to 25% (Btu basis) supplemental fuel oil assist. Ash deposition rates on a first-stage turbine nozzle sector were measured and were found to be much lower than would have been predicted from residual petroleum fuel experience because of differences in ash chemistry, and thus, deposition mechanism.

45318 **Direct coal-fueled combustion turbines.** Wenglarz, R.A. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-269.

Technology requirements for direct coal-fueled turbine systems are discussed. Combustion, emissions, and turbine life considerations are emphasized. Compact, short residence time combustors must provide acceptable combustion efficiencies and emissions using the coal fuels. The turbine flow path exposed to the products of combustion (POC) from those combustors must achieve acceptable deposition, erosion, and corrosion (DEC) lifetimes. Initial combustion and POC requirements are reviewed based on past experience and the results of a recent program to evaluate combustion, emissions, and DEC form a subscale turbine combustor.

45319 **Combustion of coal/water mixtures with thermal preconditioning.** Novack, M.; Roffe, G.; Miller, G. New York, NY; American Society of Mechanical Engineers (1987). 7p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-268.

Thermal preconditioning is a process in which coal/water mixtures are vaporized to produce coal/steam suspensions, and then superheated to allow the coal to devolitalize producing suspensions of char particles in hydrocarbon gases and steam. This final product of the process can be injected without atomization, and burned directly in a gas turbine combustor. This paper reports on the results of an experimental program in which thermally preconditioned coal/water mixture was successfully burned with a stable flame in a gas turbine combustor test rig. Tests were performed at a mixture flowrate of 300 1b/hr and combustor pressure of 8 atmospheres. The coal/water mixture was thermally preconditioned and injected into the combustor over a temperature range from 350°F to 600°F, and combustion air was supplied at between 600°F to 725°F. Test durations varied between 10 to 20 minutes. The original mean coal particle size for these tests, prior to preconditioning was 25 microns. Results of additional tests showed that one-third of the sulfur contained in the solids of a coal/water mixture with 3 percent sulfur were evolved in gaseous form (under mild thermolized conditions) mainly as H/sub 2/S with the remainder as light mercaptans.

45320 **Development of a high pressure dry coal feed system for a two-stage slagging gas turbine combustor.** Le Cren, R.T.; White, D.J. New York, NY; American Society of Mechanical Engineers (1987). 7p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-270.

Solar Turbines Incorporated, under the sponsorship of DOE-Morgantown Energy Technology Center has developed an advanced gas turbine coal-fired two-stage slagging combustor (TSSC). Rig test results using various coal-water mixtures have been reported previously (ASME85-GT-206 and 85-JPGC/GT-17). A dense-phase feed and transport system was selected as the best compromise that satisfied the various needs. The system design development included the design and testing of a splitter system that divided the primary feed into four secondary flows. A number of problems were encountered and corrected during the testing. These problems, their solutions and the final system configurations are described. A comparison of the emissions using CWM and dry micronized coal is also presented. In general, NO/sub x/ is higher and CO and UHC are lower on dry coal than on CWM because of the reduction of the reaction zone temperature by the water.

45321 **(ECE—EB.AIR/SEM.1/R.41) Elimination of SO_2 and reduction of NO/sub x/ formation through choice of appropriate fuel conversion and connected desulphurization.** Pohl, H.C.; Mueller, R. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 13p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

To minimize the amounts of undesirable by-products a process route for the energy conversion of coal to electric energy should exhibit the following characteristics: high busbar efficiency; effective methods of removal of sulfuric compounds; low NO/sub x/ formation conditions for the combustion of sulfur free gas turbine fuel gas. The combined cycle with integrated coal gasification, which consists of coal gasification, gas treatment, gas turbine, steam turbine and electric power generation, offers solutions to all these demands. The following are covered in detail: gasification; gas cleaning; NO/sub x/-suppression; dust separation; and results of environmental measures.

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REFER ALSO TO CITATION(S) 44882, 44884, 44885, 44887, 44888, 44891, 44893, 44894, 44895, 44896, 44897, 44898, 44902, 44906, 44907, 44913, 44914, 44916, 44917, 44918, 44919, 44921, 44959

45322 **(EPRI-CS—5361-Vol.1) 1987 symposium on stationary combustion nitrogen oxide control: Volume 1.** Emmel, B. (comp.). (Radian Corp., Research Triangle Park, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 527p. (CONF-870328—Vol.1). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920561.

From Joint symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The 1987 Joint Symposium on Stationary Combustion NO/sub x/ Control was held in New Orleans, Louisiana, March 23 through 26, 1987. This symposium, jointly sponsored by EPRI and EPA, had as its objective the exchange of information regarding recent technological and regulatory developments pertaining to stationary combustion NO/sub x/ control in the United States and abroad. Topics covered during the symposium included: low-NO/sub x/ combustion development; coal-, oil-, and gas-fired boiler applications; flue gas treatment; fundamental combustion studies; cyclone-fired boilers; industrial and commercial applications; and environmental and regulatory issues. The symposium proceedings is published in two volumes. All papers in Volume I, total of twenty-four, have been processed for inclusion in the Energy Data Base.

45323 **(EPRI-CS—5361-Vol.2) 1987 symposium on stationary combustion nitrogen oxide control: Volume 2.** Emmel, B. (comp.). (Radian Corp., Research Triangle Park, NC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 540p. (CONF-870328—Vol.2). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920562.

From Joint symposium on stationary combustion NO/sub x/ control; New Orleans, LA, USA (23 Mar 1987).

The 1987 Joint Symposium on Stationary Combustion NO/sub x/ Control was held in New Orleans, Louisiana, March 23 through 26, 1987. This symposium, jointly sponsored by EPRI and EPA, had as its objective the exchange of information regarding recent technological and regulatory developments pertaining to stationary combustion NO/sub x/ control in the United States and abroad. Topics covered during the symposium included: low-NO/sub x/ combustion development; coal-, oil-, and gas-fired boiler applications; flue gas treatment; fundamental combustion studies; cyclone-fired boilers; industrial and commercial applications; and environmental and regulatory issues. The symposium proceedings are

published in two volumes. All papers in Volume II, total of twenty-five, have been processed for inclusion in the Energy Data Base.

45324 **(EPRI-CS—5369) Water management in ash-handling systems: Final report.** Liang, L. (Water General Corp., Lexington, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 196p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920554.

Ash handling systems are among the major water users in fossil fueled electric power plants. Ash systems therefore are important within a plant's overall water management scheme in meeting constraints such as effluent limitations and water availability. The main objectives of the project are to survey current water management practices in ash handling systems, to review and summarize data on physical and chemical interactions between ash and water, to review methods to optimize water management, and to define research needs and the role of EPRI in meeting such needs. This report examines the role of water in bottom ash and fly ash handling systems and discusses the effect of EPA effluent limitations guidelines and standards on the performance of such systems. Current ash handling practices in the United States are summarized based on EPA plant visits, TVA sampling programs and a WPA survey of several utilities and architect/engineering firms. The characteristics of ash and the interactions between ash and water are reviewed. A number of different options for the design of water management plans for ash handling systems are also discussed. Several recommendations for EPRI research are outlined including the evaluation of mechanical bottom ash conveyor systems as an alternative to conventional bottom ash sluice systems and a data collection effort on the reliability of ash handling systems.

45325 **(PB—87-209425/XAB) Experimental study of gas use to improve the limestone-injection process for SO_2 control on utility boilers. Topical report, November 1985-September 1986.** Lange, H.B. (Energy Systems Associates, Tustin, CA (USA)). Apr 1987. 53p. (ESA—18900-343). NTIS, PC A04/MF A01.

The report describes and presents the results of a series of bench-scale experiments investigating the use of gas to improve the limestone-injection process for SO_2 removal in coal-fired utility boilers. The experiments sought to optimize the residence time and temperature of calcining in a clean, air-rich environment, created by combustion of natural gas, to produce reactive particles of calcium oxide for immediate injection into the boiler. Optimum conditions were determined for creation of a high-surface-area calcine (15 to 25+ sq m/g, depending on particle size). Optimum residence time was in the vicinity of 100 msec, making design of a compact gas burner/calciner practical. Injection of the high-surface-area calcine into a simulated boiler furnace environment showed SO_2 removal for this case to be limited by kinetic and/or diffusional processes. The data suggested that presence of SO_2 during calcination (as opposed to contacting the SO_2 immediately following calcination) may be an important process condition. A second significant observation was that introduction of ppm levels of HCl into the gas phase, with some degree of temperature elevation, substantially improves SO_2 control.

2003 Power Transmission And Distribution

45326 **(EPRI-EL—5325) Experimental analysis of drilled shaft foundations subjected to repeated axial loads under drained conditions: Final report.** Turner, J.P.; Kulhawy, F.H. (Cornell Univ., Ithaca, NY (USA). Geotechnial Engineering Group; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 345p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920588.

Drilled shaft foundations used to support transmission line structures are subjected to repeated applications of axial load. No satisfactory guidelines currently exist which provide engineers with a basis for evaluating the effects of repeated loading on drilled shaft capacity. In this study, the factors controlling the response of straight-sided drilled shafts to repeated axial loading are evaluated using load tests conducted on laboratory scale models. Small to large-scale models of drilled shafts were constructed and tested in prepared deposits of dry uniform sand. The sand deposits were instrumented with soil stress cells to measure the horizontal stresses adjacent to the shafts, and model shafts were instrumented with strain gages for measuring load transfer. Emphasis was placed on uplift capacity under two-way repeated loading. A method is described for predicting the peak to peak displacements which will occur in drilled shafts under two-way repeated axial loading as a function of the level of repeated loading and the number of load cycles. An approach is recommended to the analysis and design of drilled shafts based on limiting the displacements. 87 figs., 26 tabs.

45327 **(EPRI-EL—5353) Evaluation of an acoustic resonance temperature sensor for transformers: Final report.** Benke, F.; Dell, T.; Gannon, G.; Geil, F.; Nomm, M.; Thompson, J.; Wright, L.; Yannucci, D. (Westinghouse Electric Corp., Trafford, PA (USA). Power Equipment Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 100p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920565.

This report covers the development of a system for measuring power transformer hottest spot at high voltage under load. An acoustic sensor previously used in oceanic research was miniaturized and placed in contact with the coil. An insulating waveguide system was developed for voltage isolation; and the electronic system designed and built for readout and relay operation. The system was successfully demonstrated on one commercial order at high overloads. As much as 15° difference was shown between the presently available simulated device and the new system which measured actual hottest spot. Manufacturing cost of the sensor due to a high fallout rate as a result of sealing and waveguide attachment problems, and damage sustained after installation on the heavy coils during subsequent coil manufacture handling, preclude the use of this system at this time. 60 figs.

45328 **(EPRI-EL—5384) Bubble formation in transformers: Final report.** Fessler, W.A.; McNutt, W.J.; Rouse, T.O. (General Electric Co., San Jose, CA (USA). Advanced Nuclear Technology; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 43p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920576.

Concern has developed in recent years about the possibility of formation of gas bubbles in power transformers under certain conditions of operation. Free gas within the oil/cellulose insulation system of a transformer can be a problem because of the low dielectric strength of gases relative to either oil or cellulose. A basis is needed for predicting the specific circumstances which could lead to the generation of bubbles or, conversely, the circumstances which assuredly would avoid their generation. A mathematical model of a small subsystem within a transformer winding was constructed to define operating conditions under which free bubbles could be evolved. A predictive procedure was presented which made use of Henry's Law to determine the partial pressures of the individual dissolved gases as well as published data on water solubility in oil, the equilibrium between water concentration in cellulose and water vapor pressure, and the rate of generation of gases from the thermal degradation of cellulose. The work reported here has been largely directed to examining the correctness of these inputs on material characteristics. The algorithms employed in the model were modified as necessary in light of new information, and several cases in the original work were reexamined. Only minor modifications to the conclusions resulted. The model was then extended to consider the fact that conductor temperature is a transient function of time after load is changed and several new cases were made. 18 refs., 8 figs., 7 tabs.

45329 **(EPRI-EL—5431-Vol.1) Optical power line voltage and current measurement systems: Volume 1, Limits to the precision of electro-optic and magneto-optic sensors: Final report.** Day, G.W.; Hale, P.D.; Deeter, M.; Milner, T.E.; Conrad, D.; Etzel, S.M. (National Bureau of Standards, Washington, DC (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 122p. NTIS, PC A06/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE87014558.

This study began with a central question, "What precision can be achieved with an electro-optic voltage sensor or a magneto-

optic current sensor?" The answer has been pursued in numerous ways - through an investigation of the basic properties of materials and components (both as reported in the literature and new data generated in our laboratory), through attempts to demonstrate the feasibility of overcoming certain limitations in the properties of components, through analysis of some fundamental limitations, through the proposal of new or refined designs, and through discussions with numerous other investigators. It was concluded that ease of obtaining high precision (in a power systems context) is not included among the advantages of using optical sensors for measurement of electromagnetic quantities. The principal difficulty was that sensors have to maintain their calibration over broad temperature ranges (at least 100°C) without the possibility of temperature stabilization. Specifically, using relatively standard approaches and an appropriate definition of precision, a precision not better than about +-1% can be expected. Achieving this level of precision will require wise choices of materials, components, and design; numerous suggestions are offered.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 45130, 45418, 45420, 45421, 45433, 45434, 45435, 45436, 45437, 45438, 45439, 45440, 45442, 45575

45330 (NP—7900797, pp 70-72) **Development of computer program for generation of simulated earthquake ground motions.** Kitada, Yoshio; Sakata, Kohji. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The present regulation on earthquake-proof design for nuclear power plant requires dynamic response analyses of the structure with design spectrum-consistent simulated earthquake ground motions (SEGM) for computation of the design seismic load. In general, the SEGMs are generated to meet the design spectra of 5% damping, which usually referred to as the Ohsaki Spectra, however, those SEGMs generated by the conventional method, i.e., the Sinusoidal Wave Superimposition Method (SWSM), tend to give excessive response spectra for lower damping systems, such as equipments and piping systems, than that required by the design spectra. Since this might lead to an over-estimation of the response of these low-damping equipments and piping systems, development of better methods has been required for generation of SEGM's. Recently, two alternatives have been developed to meet the design spectra of different damping (5% and 1%) simultaneously by the working group. This paper describes a program "ATHENA" which embodies the two as the selectives for generation of SEGM's.

45331 **Trade-offs in size, quantity and reliability of generalized nuclear power plants.** Hill, D.; Mubayi, V. (Brookhaven National Lab., Upton, NY). pp 189-196 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

In the 1960's and 1970's, there was rapid growth in the size of newly started nuclear power plants because of the anticipated advantages of increasing scale. Any such advantages were overwhelmed by the complications that arose with long construction times, and attention is now being given to a "second generation" of smaller plants of new design. Providing the same production capacity will require larger numbers of plants if they are smaller. Although it seems to have received little attention previously, there should be compensating economies due to "learning curve" effects in the manufacture of multiple units of standardized designs (Hill 1983). Moreover, the use of a large number of smaller units increases the overall system reliability. On balance, however, it is not clear how scale, quantity, and reliability considerations interact to determine optimal plant size. The purpose of this paper is to begin examining the size-quantity tradeoff taking into account scale effects, the manufacturing learning curve, plant availability, and system reliability.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 45131, 45377, 45394, 45395, 45396, 45415, 45416, 45417, 45419, 45431, 45444, 45445, 45446, 45447, 45448, 45464, 45465, 45466, 45468, 45469, 45470, 45471, 45477, 45478, 45488, 45491, 45492, 45495, 45496, 45497, 45498, 45515

45332 (NP—7900797, pp 1-3) **Detailed study on ^{232}U and ^{236}U in uranium recycling.** Hida, Kazuki; Kusuno, Sadao. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Two important problems in uranium recycling are known due to uranium isotopes other than naturally occurring ones: ^{232}U leads to increased dose of external radiation on the personnel, while ^{236}U causes the reactivity loss. The processes forming ^{232}U in reactors are so complicated that computer codes such as ORIGEN have been used extensively. In addition, the self-shielding effect of ^{236}U is important to calculate the reactivity loss correctly, since the resonance absorption is dominant in ^{236}U. Therefore, a rigorous nuclear method is required to evaluate uranium recycling in detail. Therefore, a two-dimensional lattice physics computer code TGBLA with the ENDF/B-IV library was employed to study these two problems.

45333 (NP—7900797, pp 4-6) **Critical experiments on determination of power distribution by means of gamma sensitive detector in BWRs.** Tanzawa, Tomio; Mitsuhashi, Ishi; Kumanomido, Hironori; Toyoshi, Isamu. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Power distributions in an operating boiling water reactor (BWR) are calculated by the process computer using information from traversing in-core probes (TIPs). The current TIP system design consists of ionization chambers sensitive to thermal neutron. If gamma-sensitive TIPs are used instead of neutron-sensitive TIPs, the accuracies of the calculated power distribution will be improved. The reason is that signals from gamma TIP are less dependent upon detector positioning in the water gap. Critical experiments have been performed to study the following: the effects of delayed gammas on the response of the gamma detector to reactor power changes; the correlations between gamma detector signals and power distributions. Analysis of the experiments have also been performed to determine the abilities of calculational codes to predict the gamma signal response to reactor power change and the gamma signal to power correlation.

45334 (NP—7900797, pp 60-61) **Vermont Yankee stability simulation with a three-dimensional transient model.** Tsunoyama, Shigeaki; Takigawa, Yukio; Takeuchi, Yutaka; Tanabe, Akira; Sandoz, S.A. (Nippon Atomic Industry Group Co., Inc., Tokyo, Japan; Toshiba Corp.; General Electric Co.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

To improve understanding of BWR stability, many tests have been conducted. At the Peach Bottom-2 BWR plant, small pressure perturbation tests were done to identify the reactor core stability performance indices. Further a series of stability tests at the Vermont Yankee (VY) reactor was performed to obtain data under marginally stable conditions. In the tests of both plants, a pseudo-random binary signal was added on the reactor pressure regulatory and, using time series data of the neutron flux and core pressure, core stability performance was evaluated in terms of decay ratio, which is widely used as a stability performance index. In the VY tests, a limit cycle oscillation was achieved without any

excitation of pressure at the highest power under natural circulation condition. These test series are very valuable to increase the data base for the qualification of boiling water reactor stability and transient simulation models. These data were used to qualify a one-dimensional (1-D) neutronic and multiple thermal-hydraulic frequency domain model. Using a 1-D transient model, the Peach Bottom-2 Cycle 2 data were also analyzed. In this study, with a 3-D transient model; TOSDYN-2, the marginally stable conditions of VY, especially the limit cycle condition, are studied.

45335 (NP—7900797, pp 82-83) **Corrosion studies under hydrogenated water chemistry.** Uruma, Yutaka; Fukushima, Tadashi; Ichikawa, Nagayoshi; Kamata, Toshimasa. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Hydrogen gas injection into feedwater systems of commercial Boiling Water Reactors (BWRs) has successfully demonstrated in Sweden and the United States. These experiments have conducted to make insensitive environment to Stress Corrosion Cracking (SCC) for austenite stainless steel due to the suppression of dissolved oxygen concentration in primary coolant. Therefore, it is very interesting to investigate the corrosion behavior of stainless steel under lower dissolved oxygen conditions than normal BWR water chemistry. In this study, we aimed at elucidation of corrosion behavior of stainless steel by loop experiments under well controlled dissolved oxygen and dissolved hydrogen concentrations.

45336 (NP—7900797, pp 84-85) **The properties of the vitrified concentrated wastes in BWR.** Toyohara, Masumitsu; Matsuura, Hiroyuki; Kawanishi, Nobuo. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Sodium sulfate, which is a main component of concentrated wastes in BWR power plant, reacts with silica at a temperature about 1200°C to give sodium-silicate glasses under reducing conditions. Sodium-silicate glasses, which contain a large component of sodium oxide, has much solubility in water and its solutions are called "water glass." So it is necessary to add small amount of stabilizing reagents to the glasses. Aluminum and calcium oxide are generally used for stabilizing reagents. It is known that borosilicate glasses have high durability and are used for the vitrification of high level radioactive liquid wastes. The borosilicate glasses generally contain a small amount of sodium oxide (less than 10 wt %), so sodium concentration in high level wastes must be controlled to keep the quality of high level vitrified products. If the same type of borosilicate glasses are applied to the vitrification of the concentrated wastes in BWR, the satisfactory volume reduction cannot be attained because of a small capacity of sodium oxide incorporation in them. So borosilicate glasses of large components of sodium oxide were necessary to be developed. The purpose of this study is to vitrify the simulated concentrated wastes into some sodium-borosilicate glasses and to investigate the chemical durability of the products in order to decide the compositions of sodium oxide in borosilicate glasses.

45337 (NUREG/CR—4870) **An evaluation of the effects of design details on the capacity of LWR [Light-water reactor] steel containment buildings.** Greimann, L.; Fanous, F.; Rogers, J.; Bluhm, D. (Ames Lab., IA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). May 1987. Contract AC04-76DP00789. 95p. (SAND—87-7066). NTIS, PC A05/MF A01 - GPO. File Number TI87014339.

As part of their work with severe accident loadings, the Containment Integrity Division at Sandia National Laboratories has been conducting a program to evaluate the performance of containment buildings with internal pressure. It is assumed that there are no significant defects or weld flaws at which failure could initiate. This criterion is applied to strains calculated with a shell theory that includes material and geometric nonlinearities and is applied to the actual containment. In this work, drawings from nine steel containments were studied and several significant strain concentration regions were identified and classified as eccentricities in stiffener patterns around penetrations, eccentricities in the shell middle surface, flat plate covers used on spare penetrations, containment base connection details, and ellipsoidal and torispherical heads and covers. As an example of a stiffener eccentricity, the 1:8-scale model was analyzed using the shell finite element in ANSYS. Examples of each of the other classifications were analyzed by finite element and/or simplified equations. In the case of middle surface eccentricities, the strains are self-limiting. Even though flat plates have primary bending strains, they are typically designed so as not to control. In conclusion, the Sandia strain criterion is appropriate for predicting the rupture of steel containments. The failure criterion must be consistent with the level of detail in the analysis. In general, the strain limit corresponding to failure can be taken as an increasingly higher value for more detailed analysis. If detailed 3-D analyses are conducted, the strain limit may be equal to the material's ultimate strain; however, the analyst's judgment is crucial.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 45337, 45377, 45398, 45402, 45403, 45404, 45405, 45406, 45407, 45408, 45409, 45410, 45411, 45412, 45431, 45449, 45451, 45451, 45464, 45465, 45466, 45468, 45469, 45470, 45471, 45472, 45475, 45479, 45493, 45494, 45495, 45496, 45497, 45507, 45511, 45515, 46188

45338 (CONF-871013—1) **Analysis of in-core dynamics in pressurized water reactors with application to parameter monitoring.** Upadhyaya, B.R.; Sweeney, F.J.; Shieh, D.J.; Glockler, O. (Oak Ridge National Lab., TN (USA); Institute of Nuclear Energy Research, Lung-Tan (Taiwan); Tennessee Univ., Knoxville (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013181.

From 5. SMORN: international conference on reactor noise; Munich, F.R. Germany (12 Oct 1987).

The behavior of the phase relationship between neutron flux and core-exit temperature fluctuations in a pressurized water reactor (PWR) is studied as a function of the moderator temperature coefficient of reactivity (α/sub c/). PWR operational data indicate that the neutron noise and core-exit temperature noise cross power spectrum phase is linear in a certain frequency range, and approaches -180 deg at low frequencies. Extensive modeling studies applied to the LOFT reactor show that this low frequency phase behavior changes when α/sub c/ is positive, approaching zero deg at low frequencies. The analysis further showed that in the LOFT reactor, coolant flow rate fluctuation is the primary driving source causing neutron noise and core-exit temperature fluctuations. This conclusion was also confirmed by independent studies. The neutron noise-coolant temperature phase behavior may be used as a single method of monitoring the moderator temperature coefficient of reactivity during different stages of a PWR fuel cycle.

45339 (EPRI-NP—5368) **Mechanisms for formation and disruption of surface oxides: Final report.** Lumsden, J.B. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 73p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920566.

Mill-annealed alloys 600, 690 and 800 were exposed to 10 and 50% caustic solutions containing 1% Na_2CO_3 to initiate IGA. IGA reproducibly occurred in all three alloys in the 10% caustic solution at 350°C after a 240 h exposure and in the 50% caustic solution at 320°C after a 120 h exposure. Reproducible IGA did not occur in the 10% caustic solution at 320°C after a 120 h exposure. IGA was not observed in mill annealed plus thermally treated alloys 600 and 690 after exposure to any of the test conditions. IGA initiation was correlated with a dealloying mechanism in which the more active alloying metals, iron and chromium, selectively dissolve. Boric acid and calcium hydroxide additives were found to slow or prevent IGA by inhibiting dealloying. Titanates prevented

IGA in alloys 600, 690 and 800, passivating the surface with a nickel titanate film.

45340 **(EPRI-NP—5372) Probes for corrosion-related variables in LWR coolant: Interim report.** Madou, M.; McKubre, M.C.H. (SRI International, Menlo Park, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 138p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920559.

The objectives of this study were to identify, develop, and qualify a range of sensors for the measurement and control of corrosion in high temperature, flowing water, nuclear reactor heat transport systems. Sensors were developed for the quantitative determination of pH, redox potential, and dissolved hydrogen concentration. A necessary first step in the development of voltage sensors is the availability of a stable thermodynamic reference electrode suitable for use in the high temperature aqueous environments of interest, and an external, pressure balanced, reference electrode was developed for this purpose. Experiments were performed to verify sensor function under conditions simulating those in nuclear reactor aqueous heat transport systems. The results indicate that dissolved hydrogen levels can be reliably sensed in PWR primary coolant. The probes for pH and redox potential await the development of a longer-lived reference electrode which is being actively pursued.

45341 **(EPRI-NP—5377) Intergranular attack of alloy 600 tubing: Simulation tests: Interim report.** Daret, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section d'Etude de la Corrosion Aqueuse; Framatome, 92 - Paris La Defense (France); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 115p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920572.

In some steam generators, intergranular attack (IGA) has been detected on alloy 600 tubes within or near the tube sheet crevice region. Refreshed autoclave tests were performed to simulate caustic or river water in-leakage. The objective of the caustic tests was to perfect the test methodology, in order to closely simulate IGA that occurs in an actual steam generator, to identify causes and to test countermeasures in future tests. Tests with caustic pollution succeeded in producing representative IGA, and the test method is now believed applicable for studying countermeasures. The continuation of a river water fault test already tested for 4500 hours was aimed at checking if IGA was producible with only fresh water in-leakage, or if other deleterious species were involved in the cause of phenomenon. IGA was not detected for this case, which tends to indicate that another (not yet identified) specie acts as either a depassivating agent or a corrosion initiator in actual steam generators.

45342 **(KFKI—1986-99/G) 7.4 per cent cold leg break without accumulator operation. Measurement evaluation and computer analysis.** Perneczky, L.; Toth, I.; Szabados, L.; Ezsoel, Gy. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1986. 126p. (In Hungarian). NTIS (US Sales Only), PC A07/MF A01. File Number DE87703121.

A simulation technique for the loss-of-coolant failure analysis of light-water-cooled nuclear reactor is described. It has been used to analyze transient processes during a hypothetical accident and to estimate the effectiveness of built-in safety systems. The model PMK-NHV was established for these types of simulation in the Paks Nuclear Power Plant, Hungary. The first test on this simulation facility is described: a 7.4 per cent cold leg break from full power covering the blowdown phase of the accident. The pre-test analysis using the RELAP4/mod6 computer code, the evaluation of the measured data, the interpretation of the test results and the post-test calculations are presented. The work was performed within the IAEA Standard Problem Exersice (SPE). (R.P.). 7 refs.; 60 figs.; 2 tables.

45343 **(KFKI—1987-05/G) 7.4 percent cold leg break without accumulator operation. Description of the measurement.** Ezsoel, Gy.; Baranyai, G.; Csom, V. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1987. 69p. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87703124.

A simulation technique for the loss-of-coolant failure analysis of light-water-cooled nuclear reators is described. It has been used to analyze transient processes during a hypothetical accident and to estimate the effectiveness of built-in safety systems. The model PMK-NHV was established for these types of simulations in the Paks Nuclear Power Plant, Hungary. The first test on this simulation facility is described: a 7.4 per cent cold leg break from full power covering the blowdown phase of the accident. The instrumentation, the measurement arrangement and the data acquisition system is presented, and the measurement data are reported. The work was performed within the IAEA Standard Problem Exercise (SPE). (R.P.). 3 refs.; 15 figs.; 4 tables.

45344 **(NUREG—1255) Technical specifications, South Texas Project, Unit No. 1 (Docket No. 50-498): Appendix "A" to License No. NPF-71.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1987. 442p. NTIS, PC A19/MF A01 - GPO. File Number TI87900967.

This report presents specifications for the South Texas Project, Unit No. 1 concerning: safety limits, and limiting safety system settings; limiting conditions for operation and surveillance requirements; design features; and administrative controls.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 45480, 45481, 45486, 45487, 45724

45345 **(GA-A—18860) An assessment of the modular HTGR [High Temperature Gas-Cooled Reactor] containment system.** Northup, T.E.; Stansfield, O.M.; Stewart, H.B. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1987. Contract AC03-84SF11962. 10p. (CONF-870804—30). NTIS, PC A02. File Number DE87013932.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Utility/user requirements for the MHTGR provide extremely stringent criteria for radionuclide release to the environment. In response to these top-level requirements, the MHTGR has evolved as a design emphasizing passive safety features. A crucial element of the MHTGR safety concept is the containment system which places primary emphasis on retention of fission products in the fuel. In addition to the particle-coating containment, the primary system pressure boundary and reactor building designs contribute to radionuclide retention. The philosophy of the MHTGR containment system is discussed in this paper and an assessment of its effectiveness is provided.

45346 **(GA-A—18870) Annular core for Modular High-Temperature Gas-Cooled Reactor (MHTGR).** Turner, R.F.; Baxter, A.M.; Stansfield, O.M.; Vollman, R.E. (GA Technologies, Inc., San Diego, CA (USA)). Aug 1987. Contract AC03-84SF11963. 10p. (CONF-870812—29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013998.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The active core of the 350 MW(t) MHTGR is annular in configuration, shaped to provide a large external surface-to-volume ratio for the transport of heat radially to the reactor vessel in case of a loss of coolant flow. For a given fuel temperature limit, the annular core provides approximately 40% greater power output over a typical cylindrical configuration. The reactor core is made up of columns of hexagonal blocks, each 793-mm high and 360-mm wide. The active core is 3.5 m in o.d., 1.65 m in i.d., and 7.93-m tall. Fuel elements contain TRISO-coated microspheres of 19.8% enriched uranium oxycarbide and of fertile thorium oxide. The core is controlled by 30 control rods which enter the inner and outer side reflectors from above.

45347 **Helium circulator design considerations for modular high temperature gas-cooled reactor plant.** McDonald, C.F.; Nichols, M.K. New York, NY; American Society of Mechanical Engineers (1987). 10p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-138.

Efforts are in progress to develop a standard modular high temperature gas-cooled reactor (MHTGR) plant that is amenable to design certification and serial production. The MHTGR reference design, based on a steam cycle power conversion system, utilizes a 350 MW(t) annular reactor core with prismatic fuel elements. Flexibility in power rating is afforded by utilizing a multiplicity of the standard module. The circulator, which is an electric motor-driven helium compressor, is a key component in the primary system of the nuclear plant, since it facilitates thermal energy transfer from the reactor core to the steam generator; and, hence, to the external turbo-generator set. This paper highlights the helium circulator design considerations for the reference MHTGR plant and includes a discussion on the major features of the turbomachine concept, operational characteristics, and the technology base that exists in the U.S.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 45390, 45391, 45414, 45429, 45453, 45488, 45514

45348 **(CONF-870917—3) Recommended practices in elevated temperature design: A compendium of breeder reactor experiences (1970-1986): An overview.** Wei, B.C.; Cooper, W.L. Jr.; Dhalla, A.K. (Oak Ridge National Lab., TN (USA); USDOE, Washington, DC; Westinghouse Electric Corp., Madison, PA (USA)). Sep 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014413.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

Significant experiences have been accumulated in the establishment of design methods and criteria applicable to the design of Liquid Metal Fast Breeder Reactor (LMFBR) components. The Subcommittee of the Elevated Temperature Design under the Pressure Vessel Research Council (PVRC) has undertaken to collect, on an international basis, design experience gained, and the lessons learned, to provide guidelines for next generation advanced reactor designs. This paper shall present an overview and describe the highlights of the work.

45349 (IWGFR—61, pp 21-63) **French experience concerning the contamination by inactive and radioactive impurities and the purification of the cover gas of LMFBRs.** Michaille, P.; Clerc, R. (Centre d'Etudes Nucleaires de Cadarache, France). 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

With regard to the problems related to the cover gas of LMFBRs, the French position based on the experience of RAPSODIE and PHENIX can be summarized as follows: (1) no particular difficulty has been encountered with impurities such as air, the consequences of lubricant leaks were limited to the maintenance of large components; (2) concerning the contamination by radioactive species, the main source in the reactor tank is ^{23}Ne, but fortunately its half decay period is very short (38 s); (3) the analysis equipment of RAPSODIE and PHENIX evolved to account for the needs of the operator and experimental programs; (4) limited efforts have been paid to the purification techniques towards the fission products; (5) aerosol formation, transportation and trapping were considered to be of particular concern; and (6) radiological concerns were limited to some leaks in the RAPSODIE and PHENIX reactor halls: simple and efficient measures were taken to avoid this contamination.

45350 (IWGFR—61, pp 64-77) **Cover gas purification in the German LMFBR-Programme.** Schillings, K.L.; Stade, K.Ch.; Wagner, J. (Interatom GmbH, Bergisch Gladbach, West Germany). 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

A specific problem of sodium-cooled reactor plants is the purity of the noble gas argon which is used to protect the liquid alkali metal sodium in its systems in order to avoid or reduce disagreeable reactions between sodium and gaseous compounds like moisture or air and organic products like oil and grease. But as this contact cannot completely be excluded, it is necessary to recycle such contaminated cover gas. Simultaneously, this procedure has to correct the release of radioactivity. Therefore, the cover gas purification of primary systems of reactor plants contains the removal of the inorganic chemical disposal and of the nuclear waste. The German program to accomplish this is described.

45351 (IWGFR—61, pp 78-101) **Cover gas purification experience at KNK.** Richard, H.; Stade, K.Ch.; Stamm, H.H. (Kernkraftwerk-Betriebsgesellschaft m.b.H., Eggenstein-Leopoldshafen, West Germany). 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

KNK II is an experimental, sodium-cooled fast breeder reactor. The reactor was operated until 1974 with a thermal core (KNK I). The plant was converted into a fast breeder reactor (KNK II) from 1974 to 1977. The commissioning of KNK II was started in October 1977 with the first fast core KNK II/1. After 400 effective full power days (EFPD) the reactor was shut down in August 1982. After replacing the complete core with the second fast core KNK II/2, the plant went into operation again in August 1983. In August 1986 nearly 400 EFPD were achieved with the second fast core. Argon is used as cover gas in the primary and secondary sodium systems of KNK. In former times fresh argon was supplied by bundle of gas cylinders. Later on a liquid argon supply was installed. Purification of cover gas is done by flushing only. Of all non-radioactive impurities, hydrogen (H_2) and nitrogen (N_2) were of most importance in the primary cover gas. Main source of both impurities was the ingress of air and atmospheric moisture during handling operations in shutdown periods. Another possible source for hydrogen might be a release from the steel-clad zirconium hydride, used as moderator in the moderated driver fuel elements. The purification of the cover gas for KNK is discussed.

45352 (IWGFR—61, pp 102-122) **Methods and devices prepared to eliminate activation and fission products from PEC reactor cover gas.** Caponetti, R.; Gherardi, G.; Petrazzuolo, F. 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

The major effect made in Italy for the development of fast nuclear reactors is, as is known, concentrated in the PEC reactor, whose construction is now in the completion stages. The PEC reactor is a sodium-cooled reactor with a power rating of 120 MWt, being built for the purpose of studying the behavior of fuel elements under thermal and neutronic conditions similar to those of fast reactor power stations, with particular attention to safety aspects. The following topics are discussed: a description of three cover-gas circuits present in the reactor; an estimate of the contaminant conditions foreseen under operating conditions; and a description of the equipment for the purification of the cover gas and relative operating conditions.

45353 (IWGFR—61, pp 123-160) **Argon cover gas purity control on LMFBR.** Maeda, H.; Kobayashi, T.; Ishiyama, S.; Motonaga, T. 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

Various control methods for chemical impurities and radioactive materials (fission products) in the primary argon gas of

LMFBRs' were studied based on experience in JOYO and the results of research and development. These results are reflected in the MONJU design. On-line gas chromatographs are installed both in the primary and in the secondary argon gas systems in JOYO. Also, chemical analysis has been done by batch sampling in JOYO. In the MONJU design, the rare gas removal and recovery system which consisted of cryogenic distillation equipment had been eliminated and the capacity of charcoal beds in the primary argon gas system has been improved to keep the concentration of radioactive materials at sufficiently low levels. The necessity to control the impurities in fresh argon gas which is supplied to the primary argon gas system is considered to keep the concentration of Kr and Xe isotopes in specified levels, because their isotopes may make background rise for the tagging gas failed fuel detection and location system. These systems are described.

45354 (IWGFR—61, pp 161-178) **Fast reactor cover gas purification: the UK position.** Thorley, A.W. 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

The cover gas in the Prototype Fast Reactor (PFR) provides an inert gas blanket for both primary and secondary sodium circuits, ensures inert gas padding exists between the upper seals associated with penetrations through the reactor roof and provides argon to items of plant such as the control rods and the rotating shield and also to on line instruments such as the secondary circuit Katharometers. In order to meet these and other requirements purification of the argon cover gas is important. How the PFR cover gas purification system is coping with these various items and how current thinking regarding the design of cover gas purification systems for a Civil Demonstration Fast Reactor (CDFR), where larger gas volumes and higher levels of radioactivity may be involved, is being guided by current experience on PFR is described. The experimental work planned to study aerosol and cesium behavior in cover gas environments is reviewed and the behavior of those impurities such as Zn, oil and N_2 which are potentially damaging if certain levels are exceeded in operating plant is discussed.

45355 (IWGFR—61, pp 180-198) **Chemical behavior of zinc in cover gas environments.** Thorley, A.W.; Blundell, A.; Lloyd, R. 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

The possibility that enhancements of zinc-65 in the cover gas regions of reactor plants may increase levels of radioactivity and provide potentially embrittling situations has led to a limited metallurgical and chemical investigation into how this element behaves in cover gas environments. The chemical findings from those investigations are reported and the results obtained with those anticipated from thermodynamic predictions are compared.

45356 (IWGFR—61, pp 199-208) **Nitriding of steels in fast reactor cover gas environments.** Thorley, A.W.; Jeffcoat, P.J.; Kingham, M. 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

The nitriding of reactor steels by residual nitrogen levels in the argon cover gas of fast reactor systems has been investigated at RNL and CEGB to establish what effects such contaminants have on the tensile properties of certain cover gas components such as the reactor containment vessel, the above-core structure and those items of plant, such as the neutron shield rods, which protrude through the sodium surface. Generally speaking, the main areas of concern in the reactor are those items of plant which are exposed to high temperature and refluxing sodium situations. The effect of radiation on the nitriding behavior of steels of interest to the designers of FBRs has not been established in argon-nitrogen-sodium vapor environments. Neutron damage effects are not associated with cover gas regions and, therefore, the major energy in this part of the system is provided by gamma radiation mainly coming from the sodium. The estimated energy levels are 2.75 MeV and 1.37 MeV while the gamma flux at the sodium surface on the axis of the reactor is 2×10^5 Roentgens/hr.

45357 (IWGFR—61, pp 209-228) **Fast reactor primary cover gas system proposals for CDFR.** Harrison, L.M.T. 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—).

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

A primary sodium cover gas system has been designed for CDFR, it comprises a plant to maintain and control; cover gas pressure for the reactor operating a fault conditions, cover gas purity by both blowdown and by a special clean-up facility and the clean argon supply for the failed fuel detection system, and the primary pump seal purge. The design philosophy is to device a cover gas system that can be specified for any LMFBR where only features like vessel and pipework size need be altered to suit different design and operating conditions. The choice of full power and shutdown operating pressures is derived and the method chosen to control these values is described. A design for a sodium aerosol filter, based on that used on PFR is presented, it is specifically designed so that it can be fitted with an etched disc type particulate filter and maintenance is minimized. Two methods that maintain cover gas purity are described. The first, used during normal reactor operation with a small impurities ingress, utilizes the continuous blowdown associated with the inevitable clean argon purge through the various reactor component seals. The second method physically removes the impurities xenon and krypton from the cover gas by their adsorption, at cryogenic temperature, onto a bed of activated carbon. The equipment required for these two duties and their mode of operation is described. The primary pump seals require a gas purge to suppress aerosol migration. A system where the argon used for this task is recirculated and partially purified is described.

45358 (IWGFR—61, pp 229-246) **Liquid metal reactor cover gas purification and analysis in the USA.** Allen, K.J.; Meadows, G.E.; Schuck, W.J. (Argonne National Lab., IL). 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—). Contract W-31-109-ENG-38.

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

Two sodium-cooled reactors are currently being operated in the USA for the US Department of Energy. These are the Experimental Breeder Reactor II, EBR-II, and the Fast Flux Test Facility, FFTF. EBR-II is located near Idaho Falls, Idaho and the FFTF is near Richland, Washington. These reactors are currently engaged in a wide range of testing including fuels and materials tests, and plant system performance and safety development. The US DOE program also includes designs of a next generation sodium-cooled power reactor. The FFTF and EBR-II communities are providing input to these designs. The efforts to develop and operate cover gas systems for the sodium cooled nuclear reactor program in the USA are discussed.

45359 (IWGFR—61, pp 247-261) **Reactor cover gas monitoring at the Fast Flux Test Facility.** Bechtold, R.A.; Holt, F.E.; Meadows, G.E.; Schenter, R.E. (Westinghouse Hanford Co., Richland, WA). 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—). Contract AC06-76FF02170.

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

The Fast Flux Test Facility (FFTF) is a 400 MWt sodium-cooled reactor designed for irradiation testing of fuels, materials and components for LMRs. It is operated by the Westinghouse Hanford Company for the US Department of Energy on the government-owned Hanford reservation near Richland, Washington. The first 100-day operating cycle began in April 1982 and the eighth operating cycle was completed in July 1986. Argon is used as the cover gas for all sodium systems at the plant. A program for cover gas monitoring has been in effect since the start of sodium fill in 1978. The argon is supplied to the FFTF by a liquid argon Dewar System and used without further purification.

45360 (IWGFR—61, pp 262-273) **Summary of sodium vapor trap experience at the Fast Flux Test Facility.** Schuck, W.J. (Westinghouse Hanford Co., Richland, WA). 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—). Contract AC06-76FF02170.

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

Sodium vapor trap operation at the Fast Flux Test Facility has been successful although no uneventful. Analysis and evaluation of the behavior of the vapor traps associated with reactor cover gas processing and analysis systems has confirmed their design and has led to an improved understanding of these components and the environment in which they operate. This knowledge will permit simplification and reduced costs for future designs. The operation of these traps is summarized.

45361 (IWGFR—61, pp 274-283) **Radiological considerations of the reactor cover gas processing system at the FFTF.** Prevo, P.R. (Westinghouse Hanford Co., Richland, WA). 1987. NTIS (US Sales Only), PC A13/MF A01. File Number DE87900693. (CONF-8609227—). Contract AC06-76FF02170.

From IAEA specialists meeting on fast reactor cover gas purification; Richland, WA, USA (24 Sep 1986).

Radiological and environmental protection experience associated with the reactor cover gas processing system at the Fast Flux Test Facility (FFTF) has been excellent. Personnel radiation exposures received from operating and maintaining the reactor cover gas processing system have been very low, the system has remained free of radioactive particulate contamination through the first seven operating cycles (cesium contamination was detected at the end of Cycle 8A), and releases of radioactivity to the environment have been very low, well below environmental standards. These three aspects of fast reactor cover gas purification over the first eight operating cycles of the FFTF (a duration of a little more than four years, from April 1982 through July 1986) are discussed.

45362 (NP—7900797, pp 7-9) **Analysis of JOYO burnup data and their interpretation in terms of cross section adjustment.** Kawashima, Masatoshi; Yoshida, Tadashi; Iijima, Shungo; Ikegami, Tetsuo. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Power Reactor and Nuclear Fuel Development Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The experimental fast reactor 'JOYO' provides us with important knowledge on fast reactor neutronics including information on fuel-burnup, which cannot be obtained in critical experiments. These data are, however, relatively difficult to interpret for practical applications. One reason is that the core size and the neutron spectrum of 'JOYO' are fairly different from those of large FBRs, or design targets. In this respect, the cross-section adjustment method has an advantage over the bias-factor method when one intends to extract relevant information to design calculations of large FBRs. In the present work, the data taken in the whole history of the JOYO Mark-I core operation were analyzed. The cross-section adjustment was then carried out on the basis of the results of this analysis in order to see the consistency between the burnup and other data and to see the implications on the cross-sections and the methods used.

45363 (NP—7900797, pp 10-12) **Evaluation of prediction accuracy of burnup characteristics in a large LMFBR.** Kamei, Takanobu; Yoshida, Tadashi. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Prediction accuracy of core performance parameters of large LMFBRs has definitely been improved by the accumulation of the experimental data taken through the zero-power critical experiments, among which there is the US-Japan cooperative JUPITER program conducted at the ZPPR-facility. The neutronics properties connected with the reactor burnup, however, cannot be studied directly by experiments in the zero-power facilities. In 1980 almost ten organizations over the world participated in a NEA Burnup Benchmark of large LMFBRs. The reactivity loss of 365 day burnup calculated by the different organizations scattered from 0.5 to 1.9% $\Delta k/k$, revealing the large uncertainty inherent to FBR burnup calculations. In the present work the prediction error of the burnup properties was quantitatively evaluated on the basis of a sensitivity analysis.

45364 (NP—7900797, pp 21-23) **Error propagation in Monte Carlo coupling calculation.** Kawai, Masayoshi; Hayashida, Yoshihisa. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

An albedo Monte Carlo (AMC) code system MORSE-ALB has been developed to cope with problem of radiation streaming through a cavity. For the analysis of radiation distribution in the long streaming paths, an AMC-AMC coupling technique is useful to save exhausting computer time in single MC calculation. However, the coupling technique requires an estimation of error propagation in the MC-MC coupling calculation. Accordingly, a new formulation of error propagation was devised and applied to the analysis of the measured data of neutron streaming through the primary coolant pipe chase-way in the Japanese experimental fast reactor "JOYO." This paper presents the results of the investigation.

45365 (NP—7900797, pp 27-30) **Evaluation of the expected number of failure pins in a prototype FBR core by the BORNFREE code.** Shirakawa, Noriyuki; Tsuboi, Yasushi; Tanaka, Kenya. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.; Power Reactor and Nuclear Fuel Development Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The evaluation of the LMFBR fuel performance is exposed to various kinds of parameter uncertainties, such as designed geometries, material properties, operational conditions and so on. The BORNFREE code has been developed to take into account these uncertainties systematically and consistently in the evaluation of the fuel integrity under normal operation. The physical and the probabilistic models were described in Ref. (1) and the results of the evaluation of the prototype FBR fuel performance were presented in Ref. (2), where local probability density functions (PDFs) of damage indicies (damage fraction or temperature) at multi-spots in a fuel subassembly were presented. Global code structure of BORNFREE has been modified thereafter, to offer the following functions: (1) evaluation of the expected number of failed pins in a whole core, (2) PDF sensitivity analysis. This report briefly describes these functions, the evaluation of failed or melt pin expectation and the results of PDF sensitivity analysis about melt pin expectation.

45366 (NP—7900797, pp 31-36) **Feasibility study on generalized sensitivity analysis method and its application to thermal-hydraulic problem.** Ohta, Shuichi; Shirakawa, Noriyuki; Kajiwara, Hikaru. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The generalized sensitivity analysis method (GSAM) is a method to get linear response sensitivity of a system to various parameters by making use of an adjoint solution of the system equations. When the adjoint solution for a fixed response functional is once derived, the responses of the system for all parameters are immediately calculated by the integration of the sensitivity equation, which is a function of forward and adjoint solutions. This adjoint solution also has a meaning of, so-called, 'importance distribution'

in the sense of reactor physics and offers illuminating informations about the effect of parameter changes to the system response. The objective of this study is to interpret the GSAM theory, and to apply it to a thermal-hydraulic problem in a nuclear reactor and to find usefulness and limitations of this method.

45367 (NP—7900797, pp 37-39) **An axially and radially two-zoned large LMFBR core concept.** Kamei, Takanobu; Yamaoka, Mitsuaki; Moriki, Yasuyuki; Suzuki, Masao; Arie, Kazuo. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

In order for fast reactors to be utilized as commercial reactors, the reactors have to be endowed with enough safety and have to be constructed in comparable cost with facilities of other energy sources. In the present study, a new core concept is evolved to attain this goal. The new core concept has several favorable features over the conventional homogeneous cores in neutronics characteristics such as power peaking factor, burnup reactivity loss and reactivity response to the movement of control rods in earthquakes.

45368 (NP—7900797, pp 40-41) **Analysis of the 'JOYO' Natural Circulation Test (III): Short term behavior of outlet coolant temperature.** Ohta, Shuichi; Shirakawa, Noriyuki; Kajiwara, Hikaru. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

In the previous note about the 'JOYO' Natural Circulation Test-E, we have reported the results of a detailed study on the short term and long term transient behaviors of outlet coolant temperature in the center subassembly (S/A). One of the conclusions drawn from this study was that irradiation history of fuel pins during normal operation has a significant influence on the short term behavior of outlet coolant temperature. To pursue this problem further, the SIEX code, which calculates FBR fuel pin performance during steady state, was incorporated into the transient analysis code MIMIR-N2. Test-E was recalculated by this modified MIMIR-N2. During the course of this study, it was identified that the discrepancy of short term outlet coolant temperature between calculations and the experiment came from the following items: steady state fuel irradiation history including gap and conductance; transient gap conductance; and response time of thermocouples. The purpose of this study is to find, by the modified MIMIR-N2, how these items influence outlet coolant temperature behavior and then to clarify the effect of two-dimensional flow in the upper core structure region, on outlet coolant temperatures in the subassemblies.

45369 (NP—7900797, pp 42-45) **Analysis of the 'JOYO' Natural Circulation Test (IV): In-vessel 2-D thermal-hydraulic analysis.** Kajiwara, Hikaru; Ohta, Shuichi; Hirao, Kazunori. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Power Reactor and Nuclear Fuel Development Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

In this study the COMMIX-1A code was employed to take multidimensional, thermal hydraulic effects on the measured temperature at the subassembly exit into account. COMMIX-1A is a steady and/or transient, three-dimensional and single-phase computer code developed for thermal-hydraulic analysis of reactor components. It employs the porous media approach in which the concepts of volume porosity, surface permeability, distributed resistance and heat source are used to model the complex features of reactor components. This report briefly describes the in-vessel structure configurations for the COMMIX-1A and the results of the multi-dimensional analysis of the 75 MWt natural circulation test (TEST-E).

45370 (NP—7900797, pp 46-48) **Validation of a fuel bundle mechanical performance code "Etoile" with BDI experimental data.** Nakagawa, Masatoshi. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Validation of "ETOILE" code with the experimental data from the BDI (Bundle-Duct Interaction) tests published by HEDL is discussed. Computer program ETOILE has been developed for the purpose of predicting the fuel pin bundle distortions and mechanical behavior during irradiation in LMFBR cores. The code, which utilizes the finite element method and takes account of the spacer wire tension effect, is capable of treating up to 271 fuel pins in a subassembly, and up to 20 turns of spiral wires. This report describes the comparisons between the measured bundle stiffnesses and calculated results by ETOILE.

45371 (NP—7900797, pp 49-51) **Optimization in FBR shielding design.** Uematsu, Mikio; Kawai, Masayoshi. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

In FBR shielding design, reduction of secondary coolant activation is one of the most important subjects, but a simple reinforcement of shieldings generally degrades earthquake-proof property and increases plant cost. We studied shielding optimization method by applying forward-adjoint folding code FANCY to the calculation of secondary sodium coolant activation rate in invessel intermediate heat exchanger (IHX) of FBR. The forward-adjoint folding technique, in which adjoint fluxes around the heat exchangers are calculated separately from forward calculation, simplifies not only calculational model of FBR, but also calculational steps in FBR shielding design.

45372 **Nuclear reactor construction with bottom supported reactor vessel.** Sharbaugh, J.E. (to Dept. of Energy, Washington, DC). US Patent 4,681,731. 21 Jul 1987. Filed date 6 Nov 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an improved liquid metal nuclear reactor construction comprising: (a) a nuclear reactor core having a bottom platform support structure; (b) a reactor vessel for holding a large pool of low pressure liquid metal coolant and housing the core; (c) a containment structure surrounding the reactor vessel and having a sidewall spaced outwardly from the reactor vessel side wall and having a base mat spaced below the reactor vessel bottom end wall; (d) a central small diameter post anchored to the containment structure base mat and extending upwardly to the reactor vessel to axially fix the bottom end wall of the reactor vessel and provide a center column support for the lower end of the reactor core; (e) annular support structure disposed in the reactor vessel on the bottom end wall and extending about the lower end of the core; (f) structural support means disposed between the containment structure base mat and bottom end of the reactor vessel wall and cooperating for supporting the reactor vessel at its bottom end wall on the containment structure base mat to allow the reactor vessel to expand radially but substantially prevent any lateral motions that might be imposed by the occurrence of a seismic event; (g) a bed of insulating material disposed between the containment structure base mat and the bottom end wall of the reactor vessel and uniformly supporting the reactor vessel at its bottom end wall; freely expand radially from the central post as it heats up while providing continuous support thereof; (h) a deck supported upon the wall of the containment vessel above the top open end of the reactor vessel; and (i) extendible and retractable coupling means extending between the deck and the top open end of the reactor vessel and flexibly and sealably interconnecting the reactor vessel at its top end to the deck.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 45480, 45484, 45493, 45494, 45554

45373 **(NUREG—0304-Vol.12-No.2) Regulatory and technical reports: Abstracts index journal: Compilation for second quarter, April-June 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Aug 1987. 59p. NTIS, PC A04 - GPO. File Number TI87900959.

This journal includes all formal reports in the NUREG Series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstracts, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

45374 **(NUREG—0750-Vol.25-No.4) Nuclear Regulatory Commission issuances, April 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Apr 1987. 160p. NTIS, PC A08/MF A01 - GPO. File Number DE87900999.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

45375 **(NUREG—0940-Vol.6-No.2) Enforcement actions: Significant actions resolved: Quarterly progress report, April-June 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement). Aug 1987. 398p. NTIS, PC A17/MF A01. File Number TI87900966.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (April-June 1987) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

45376 **(NUREG—1275) Operating experience feedback report: New plants, Commercial power reactors.** Dennig, R.L.; O'Reilly, P.D. (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Jul 1987. 283p. NTIS, PC A13/MF A01 - GPO. File Number DE87900969.

This report documents a detailed review of the cause of unplanned events during the early months of licensed operation for plants licensed between March 1983 and April 1986. The major lessons and corrective actions that appear to have the greatest potential for improving the effectiveness of plant startups are provided for consideration through the operating experience feedback programs and activities of the industry and the NRC staff.

45377 **(NUREG/CR—2000-Vol.6-No.7) Licensee Event Report (LER) compilation for month of July 1987.** (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Aug 1987. Contract AC05-84OR21400. 148p. (ORNL/NSIC—200-Vol.6-No.7). NTIS, PC A07/MF A01 - GPO. File Number TI87014774.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

2108 Economics

REFER ALSO TO CITATION(S) 45433, 45436

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 46961

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 45087, 45393, 45432, 45489, 45490

45378 **(CONF-871045—4) Subcritical interaction experiments with four safe storage bottles containing aqueous uranyl nitrate.** Mihalczo, J.T.; Blakeman, E.D.; Ragan, G.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02. File Number DE87011939.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

The subcritical neutron multiplication factor has been measured previously by the ^{252}Cf-source-driven neutron noise analysis method for a variety of noninteracting single systems with a wide variety of materials and geometries. For these single systems the neutron multiplication, k/sub eff/, varied between 0.33 and 0.99, and in one experiment, the k/sub eff/ value varied with time up to rates of 0.01/s. Interaction experiments with two coupled units and with three strongly coupled tanks have also been completed. The experiments reported here are the first application of this method to arrays of four units, a necessary step in understanding interacting systems with a large number of units. The experimental approach was to search experimentally for source-detector locations that would allow point kinetics interpretation of the data, and to provide sufficient variation of source and detector locations to support the testing of theoretical models that include spatial effects for studying the interactions of fissile systems.

45379 **(CONF-871045—7) ^{252}Cf-source-driven neutron noise measurements of subcriticality for a slab tank containing aqueous Pu-U nitrate.** Mihalczo, J.T.; Blakeman, E.D.; Ragan, G.E.; Kryter, R.C.; Robinson, R.C.; Seino, H. (Oak Ridge National Lab., TN (USA); Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Aug 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02. File Number DE87013676.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

In order to study nuclear criticality safety related to the development of fast breeder technology, ^{252}Cf-source-driven neutron noise analysis measurements were performed with a Pu-U nitrate solution in a slab tank of various heights and thickness varying 11.43 cm to 19.05 cm. The results and conclusions of these experiments are (1) a capability to measure the subcriticality of a multiplying system of slab geometry to a k/sub eff/ as low as 0.7 was demonstrated, (2) calculated neutron multiplication factors agreed with those from the experiments within ~0.02, and (3) the applica-

bility of the method for plutonium solution systems was demonstrated. This paper describes measurements in which the height of the slab was varied for a fixed thickness and the thickness varied for a fixed height, which are the first applications of this measurement method to slab geometry.

45380 **(LA—10860-MS) Critical dimensions of systems containing ^{235}U, ^{239}Pu, and ^{233}U; 1986 Revision.** Paxton, H.C.; Pruvost, N.L. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87012702.

This report is primarily a compilation of critical data obtained from experiments performed in a number of laboratories during the period of 1945 through 1985. It supplements the Nuclear Safety Guide [Report TID-7016 (Rev. 2)] in presenting critical data on which recommendations of the Guide are based. It must be emphasized that this report gives critical data without safety factors, so it is no substitute for the Guide or for the related document, The American National Standard for Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors. Critical measurements with materials of interest in desired configurations yield information of greatest usefulness and accuracy. Where it is not feasible to obtain the desired critical data, for example, as a result of safety restrictions, subcritical data may be directly applicable, and in some cases may be extrapolated to approximate critical conditions. Critical conditions also may be approximated from the distribution of neutrons introduced into a subcritical assembly. These "exponential experiments" may be the only alternative where the quantity of material required is too great for a critical experiment. Calculated extensions of experimental data are included to show the nature of trends, not to substitute for results of experiments. They should be used with caution. A fundamental aim of this document is to illustrate relationships among critical data. The compilation and correlation of data for this purpose, from many measurements in a number of laboratories, require a certain amount of normalization or reduction to common terms. Frequently, for example, the effects of variations in geometry or density must be removed to show trends in data. The manner in which these alterations may be made is discussed in the early section Relations for Conversion to Standard Conditions. 195 refs.

45381 **(LA-UR—87-1484) The Los Alamos Critical Experiments Facility Program.** Dowdy, E.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-871045—2). NTIS, PC A02. File Number DE87010100.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

Critical assemblies of precisely known materials and reproducible and easily calculated geometries have been constructed at the Los Alamos National Laboratory since the 1940s. Initially, these assemblies were built to provide information necessary for the nuclear weapons development effort. Subsequently, intensive studies of the assemblies themselves were undertaken to provide a better understanding of the physics of the fission process and other nuclear reactions in the nuclear materials from which these machine were constructed and in other materials irradiated in these assemblies. Some of these assemblies (notably Jezebel, Flattop, Big Ten, and Godiva) have been used as benchmark assemblies to compare the results of experimental measurements and computations of certain nuclear reaction parameters. These comparisons are used to validate both the input nuclear data and the computational methods. In addition to these normally fueled benchmark assemblies, other assembly machines are fueled periodically to provide specific and detailed results for parameter sensitivity studies for a large number of applications. Some of these machines and their applications are described.

45382 (NP—7900797, pp 17-20) **Nuclear data evaluation and methodology.** Iijima, Shungo; Murata, Tohru; Kawai, Masayoshi; Yoshida, Tadashi; Hida, Kazuki; Yamamuro, Nobuhiro. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; NAIG Nuclear Research Lab., Kawasaki, Kanagawa). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The gamma-ray production data of Gd (A = 154 to 158 and 160), ^{181}Ta, ^{239}Pu and ^{240}Pu have been evaluated in the neutron energy range from thermal to 20 MeV. Since experimental data are scarce, the present evaluations are based mainly on the theoretical calculation. The neutron energy range is divided into two regions at an energy below which the inelastic scattering excites only the discrete levels whose gamma-ray branching ration are well known. In the low energy region, the gamma-ray multiplicities were evaluated separately for the neutron capture and the inelastic scattering. Capture gamma-ray spectra and the multiplicities were calculated with the CASTHY code. The multiplicities of gamma-ray following the inelastic scattering were obtained mostly from the experimental data on branching ratios. In the high energy region, the gamma-ray spectra and the multiplicities were calculated with the NGROGI code (multi-step evaporation model) for Gd and Ta, and with the GNASH code (multi-step statistical model) for Pu. In the evaluation of Pu, the NGROGI code was also used to compare the results with the ones of GNASH. In the present work, the effect of the pre-equilibrium process by analyzing gamma-ray production cross section for iron has also been studied. Discussions of multilevel resonance cross section calculation and decay heat calculation (including neutron capture) have also been presented.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 45393, 45495, 45500, 45501, 45502, 45503, 45506, 45509, 45510

45383 **(DOE/NE/37959—9) An integrated approach for signal validation in nuclear power plants.** Upadhyaya, B.R.; Kerlin, T.W.; Gloeckler, O.; Frei, Z.; Qualls, L.; Morgenstern, V. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Aug 1987. Contract AC02-86NE37959. 9p. (CONF-870832—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014227.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

A signal validation system, based on several parallel signal processing modules, is being developed at the University of Tennessee. The major modules perform (1) general consistency checking (GCC) of a set of redundant measurements, (2) multivariate data-driven modeling of dynamic signal components for maloperation detection, (3) process empirical modeling for prediction and redundancy generation, (4) jump, pulse, noise detection, and (5) an expert system for qualitative signal validation. A central database stores information related to sensors, diagnostics rules, past system performance, subsystem models, etc. We are primarily concerned with signal validation during steady-state operation and slow degradations. In general, the different modules will perform signal validation during all operating conditions. The techniques have been successfully tested using PWR steam generator simulation, and efforts are currently underway in applying the techniques to Millstone-III operational data. These methods could be implemented in advanced reactors, including advanced liquid metal reactors.

45384 **(DOE/NE/37959—10) Functional consistency checking module for signal validation: Topical report.** Zwingelstein, G.; Kerlin, T.W.; Upadhyaya, B.R. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering; Electricite de France, 78 - Chatou). Aug 1987. Contract AC02-86NE37959. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014338.

This report discusses the basic principles of a functional consistency checking module for signal validation in nuclear plants. This module will add additional features to the signal validation system currently being designed at the University of Tennessee. The goals of the functional consistency module are to provide solutions to the common mode features and single or dual sensor failures. The basic principle lies in the comparison of the actual outputs and outputs derived from reference static or dynamics models. The only requirement needed for this method is that the plant must be decomposed into subsystems with observable inputs and outputs.

The reference models can be either empirical or derived from physical laws. The main feature of this module is its capability to separate component failures from sensor failures. The failures which can be isolated are bias, drifts, absormal noise or changes in the dynamic sensor characteristics. The decision-making process relies basically on truth table look-up. The truth table contents are derived from an apriori knowledge of the failure causes. More elaborate decision making processes based on pattern recognition techniques or expert systems are proposed to improve the reliability of the decisions. A modified sequential probability ratio test is suggested to handle adequately the modeling errors. The proposed functional consistency checking is valid for both steady state and transient conditions. In the latter case, the transfer functions of the instrumentation channels must be taken into account for a fast and accurate failure identification. To conclude the report, anticipated benefits of the functional consistency checking are listed.

45385 **(EPRI-NP—4867M) Concrete containment tests: Phase 2, Structural elements with liner plates: Interim report.** Hanson, N.W.; Roller, J.J.; Schultz, D.M.; Julien, J.T.; Weinmann, T.L. (Construction Technology Labs., Skokie, IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 116p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920560.

The tests described in this report are part of Phase 2 of the Electric Power Research Institute (EPRI) program. The overall objective of the EPRI program is to provide a test-verified analytical method of estimating capacities of concrete reactor containment buildings under internal overpressurization from postulated degraded core accidents. The Phase 2 testing included seven large-scale specimens representing structural elements from reinforced and prestressed concrete reactor containment buildings. Six of the seven test specimens were square wall elements. Of these six specimens, four were used for biaxial tension tests to determine strength, deformation, and leak-rate characteristics of full-scale wall elements representing prestressed concrete containment design. The remaining two square wall elements were used for thermal buckling tests to determine whether buckling of the steel liner plate would occur between anchorages when subjected to a sudden extreme temperature differential. The last of the seven test specimens for Phase 2 represented the region where the wall and the basemat intersect in a prestressed concrete containment building. A multi-directional loading scheme was used to produce high bending moments and shear in the wall/basemat junction region. The objective of this test was to determine if there is potential for liner plate tearing in the junction region. Results presented include observed behavior and extensive measurements of deformations and strains as a function of applied load. The data are being used to confirm analytical models for predicting strength and deformation of containment structures in a separate parallel analytical investigation sponsored by EPRI.

45386 (INIS-mf—10947, pp 112) **Use of expert systems for technical diagnostics in nuclear power engineering.** Marik, V.; Zdrahal, Z. (Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia. Fakulta Elektrotechnicka). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

45387 **(KFK—4254) Application of viscoplastic constitutive equations in finite element programs.** Hornberger, K.; Stamm, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Zuverlaessigkeit und Schadenskunde im Maschinenbau). Apr 1987. 60p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10829.

The general mathematical formulation of frequently used viscoplastic constitutive equations is explained and Robinson's model is discussed in more detail. The implementation of viscoplastic constitutive equations into Finite Element programs (such as ABAQUS) is described using Robinson's model as an example. For the numerical integration both an explicit (explicit Euler) and an implicit (generalized midpoint rule) integration scheme is utilized in combination with a time step control strategy. In the implicit integration scheme, convergence in solving a system of nonlinear algebraic equation is improved introducing a projection method. The efficiency of the implemented procedures is demonstrated for different homogeneous load cases as well as for creep loading and strain controlled cyclic loading of a perforated plate.

45388 **(NUREG/CR—4590-Vol.1) Aging of nuclear station diesel generators: Evaluation of operating and expert experience: Phase 1, Study.** Hoopingarner, K.R.; Vause, J.W.; Dingee, D.A.; Nesbitt, J.F. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Aug 1987. Contract AC06-76RL01830. 298p. (PNL—5832-Vol.1). NTIS, PC A13/MF A01 - GPO. File Number TI87014101.

Pacific Northwest Laboratory evaluated operational and expert experience pertaining to the aging degradation of diesel generators in nuclear service. The research, sponsored by the US Nuclear Regulatory Commission (NRC), identified and characterized the contribution of aging to emergency diesel generator failures. This report, Volume I, reviews diesel-generator experience to identify the systems and components most subject to aging degradation and isolates the major causes of failure that may affect future operational readiness. Evaluations show that as plants age, the percent of aging-related failures increases and failure modes change. A compilation is presented of recommended corrective actions for the failures identified. This study also includes a review of current, relevant industry programs, research, and standards. Volume II reports the results of an industry-wide workshop held on May 28 and 29, 1986 to discuss the technical issues associated with aging of nuclear service emergency diesel generators.

45389 **A systematic and cost effective approach to nuclear plant life extension.** Massie, H.W.; Katz, L.R. (Westinghouse Electric Corp., Pittsburgh, PA). pp 31-34 of Proceedings of the international conference on nuclear power plant aging, availability factor and reliability analysis. Goel, V.S. Metals Park, OH; American Society for Metals (1985). (CONF-850713—).

From International conference on nuclear power plant aging, availability factor and reliability analysis; San Diego, CA, USA (7 Jul 1985).

Westinghouse is heavily involved in the nuclear and fossil plant life extension efforts including the life extension study of the Surry Unit No. 1 plant. This study is funded by Virginia Electric Power Co. (VEPCO), Electric Power Research Institute, Inc. (EPRI), the U.S. Department of Energy (DOE), and the Westinghouse Owners Group (WOG). The authors propose that most utilities conduct a phased approach to Plant Life Extension (PLEX) utilizing input from the VEPCO/EPRI/DOE/WOG pilot study as well as their own plant unique information. Because of the lead times involved in the construction and licensing of new plants, it is recommended that utilities initiate their plant life extension programs now.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 45363, 45488

2204 Control Systems

REFER ALSO TO CITATION(S) 45444, 45445, 45446, 45447, 45448, 45488, 45492

45390 **(ANL-FRA—160) A user's guide to the SASSYS-1 control system modeling capability.** Vilim, R.B. (Argonne National Lab., IL (USA)). Jun 1987. Contract W-31109-ENG-38. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014429.

This report describes a control system modeling capability that has been developed for the analysis of control schemes for advanced liquid metal reactors. The general class of control equations that can be represented using the modeling capability is identified, and the numerical algorithms used to solve these equations are described. The modeling capability has been implemented in the

SASSYS-1 systems analysis code. A description of the card input, a sample input deck and some guidelines for running the code are given.

45391 **(CONF-870418—3-FP) Plant inherent control testing in EBR-II.** Chang, L.K.; Mohr, D.; Feldman, E.E.; Planchon, H.P. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 19p. NTIS, PC A02. File Number DE87011532.

From Topical meeting on anticipated and abnormal transients in nuclear power plants; Atlanta, GA, USA (12 Apr 1987).

Recent tests in the Experimental Breeder Reactor II (EBR-II) have demonstrated that reactor feedbacks can passively reduce power and thus effectively mitigate reactor undercooling caused by equipment failures. A follow-on testing program is being designed to investigate the use of these feedbacks along other liquid metal reactor (LMR) characteristics to routinely control reactor power during plant maneuvers and fuel burnup, compensation, and to limit the possibility and consequences of over-power accidents. In all of the tests described in the present paper, the control rods will not be used as the plant is maneuvered over the power range between 40 and 100%. The plant variables (forcing functions) employed in the power control include the primary flow, the secondary flow, and the turbine admission position. The pretest predictions for the tests are presented and a preliminary analysis on the effects of controller failures is discussed. This paper provides concepts in reactor power control which may lead to fundamental changes in design and safety consideration of metal fueled LMRs.

45392 **(CONF-8710101—1) Integrated operator-plant process modeling and decision support for allocation of function.** Schryver, J.C.; Knee, H.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011942.

From 31. annual Human Factors Society meeting; New York, NY, USA (19 Oct 1987).

Human operator simulation models can play an important information role in the allocation of functions in person-machine systems. A prototype simulation model system developed at ORNL is described in which a human operator model (INTEROPS) and a nuclear power plant (NPP) process model are dynamically integrated. INTEROPS is a cognitive/performance simulation model which is itself a dynamic integration of a SAINT task network model and a knowledge-based subsystem which reasons with uncertainty. Potential contributions of INTEROPS to NPP advanced control design are evaluated. 8 refs., 3 figs.

45393 **(EPRI-NP—5227M) Advanced core-monitoring framework: Computer code manual.** Ipakchi, A.; Khadem, M.; Chen, H.J.; Christler, G.; Peng, C.M. (Systems Control, Inc., Palo Alto, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1987. 127p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920584.

The Advanced Core Monitoring Framework (ACMF) provides a standard software framework within which modules from any core monitoring systems could be readily installed. This enables a utility to implement, or have implemented, application and standard modules which are available from EPRI or from specific vendors. The framework thus enables a smooth transition between different fuel vendors by allowing the use of the most appropriate core monitoring capabilities, while at the same time providing for continuity of usage and support. This computer code manual documents ACMF software through its initial implementation phase, completed on December 31, 1985.

45394 **(EPRI-NP—5311) Utility machinery vibration monitoring guide: Final report.** Moore, T.T.; Thomas, C.C. (Radian Corp., Austin, TX (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 353p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920585.

Section I of this guide presents a methodology for developing machinery vibration monitoring programs specifically designed for application within the utility industry. The methodology is designed to enhance a monitoring program and can be used at the outset of program development or as a reference after programs have been started. Section I evaluates all aspects of the monitoring program, including Objectives and Goals, Information Type, Timing & Format, Data Analysis, Data Acquisition, Measurement and Transducer Selection, Personnel and Organization, Program Instrumentation, Program Costs, Program Justification, and Implementation of a Monitoring Program. The methodology is then applied to two host utility plants in Section II, which contains the monitoring programs developed by Gulf States Utilities and Philadelphia Electric Company using this guide. Section III contains the histories of several different types of existing utility monitoring programs. Some of the lessons learned, including the recommendations of these "mature" programs for persons starting new programs, are included.

45395 **(EPRI-NP—5366) Compact analyzer for BWR [Boiling Water Reactor] applications: Final report.** May, R.S. (Levy (S.), Inc., Campbell, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 178p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920581.

Experiences of recent years have demonstrated the need for utilities operating nuclear power plants to effectively analyze operational transient events and to train their staffs to understand the basic features of such events. The EPRI program to develop a Company Analyzer combines modeling capabilities of the EPRI Modular Modeling System (MMS) with real-time graphic display capabilities of the EPRI Information Monitoring and Applied Graphics Environment (IMAGE). The result is an integrated system which: (a) allows a user to interactively define transient events and perform important control functions; (b) performs transient analyses on a host minicomputer; and (c) updates colorgraphic displays in real-time to present the results. The Boiling Water Reactor (BWR) Compact Analyzer includes a plant model representing the BWR core and vessel, important control and protection systems, and balance of plant including feedwater heaters, high and low pressure turbines and extraction lines. As an option, the user may choose to model only the nuclear steam supply system, with the balance of plant interfaces treated only as boundary conditions. A set of color displays was developed which includes mimics of the vessel, balance of plant, and safety systems, as well as a system overview display and time-plots of key parameters. The architecture of the Compact Analyzer system is documented in detail. This project has culminated in a prototype system demonstrating the Compact Analyzer for Boiling Water Reactor applications.

45396 **(EPRI-NP—5370) Improved control rod drive handling equipment for BWRs [boiling-water reactors]: Final report.** Turner, A.P.L.; Gorman, J.A. (Dominion Engineering, Inc., McLean, VA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 118p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920567.

Improved equipment for removing and replacing control rod drives (CRDs) in BWR plants has been designed, built and tested. Control rod drives must be removed from the reactor periodically for servicing. Removal and replacement of CRDs using equipment originally supplied with the plant has long been recognized as one of the more difficult and highest radiation exposure maintenance operations that must be performed at BWR plants. The improved equipment was used for the first time at Quad Cities, Unit 2, during a Fall 1986 outage. The trial of the equipment was highly successful, and it was shown that the new equipment significantly improves CRD handling operations. The new equipment significantly simplifies the sequence of operations required to lower a CRD from its housing, upend it to a horizontal orientation, and transport it out of the reactor containment. All operations of the new equipment are performed from the undervessel equipment handling platform, thus, eliminating the requirement for a person to work on the lower level of the undervessel gallery which is often highly contaminated. Typically, one less person is required to operate the equipment than were used with the older equipment. The new equipment incorporates a number of redundant and fail safe features that improve operations and reduce the chances for accidents.

45397 **(HEDL-SA—3631-FP) Analyses of eigenvalue bias and control rod worths in FFTF [Fast Flux Test Facility].** Nelson, J.V.; Dobbin, K.D.; Wootan, D.W.; Campbell, L.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 1987. Contract AC06-76FF02170. 7p. (CONF-870917—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014380.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

The Fast Flux Test Facility (FFTF) core loading during its ninth operating cycle was significantly different from that of previous cycles because of the presence of the Core Demonstration Experiment (CDE). The CDE consists of a number of axially blanketed fuel assemblies and internal blankets prototypic of advanced oxide cores in Liquid Metal Reactors (LMR). In preparation for the Cycle 9 reload design effort, a careful assessment of control rod worth and reactivity calculations for Cycles 1 through 8 was made. The goal of this study was to establish calculational biases and reduce uncertainties factored into the reload design calculations. These analyses helped assure that the operational objectives for Cycle 9 were met.

45398 **(INIS-mf—10947) Software for diagnostic systems of nuclear power plants.** (Skoda, Plzen (Czechoslovakia). Zavodni Pobocka Ceske Vedeckotechnicke Spolecnosti). 1986. 106p. (In Czech and Slovak). (CONF-8606327—). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905.

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The proceedings contain papers presented at the seminar which was held in Plzen, Czechoslovakia, on June 3 and 4, 1986. 16 papers fall under the INIS subject scope: those which are concerned with the development and first experiences gained with the software for diagnostic systems designed for Czechoslovak nuclear power plants with WWER reactors. Seven papers are published in abstract form, their full texts are published in the journal Automatizace (1986), No. 5. (Z.M.).

45399 (INIS-mf—10947, pp 49-59) **Projects of an in-service diagnostic system.** Forejt, V. (Skoda, Plzen, Czechoslovakia. Zavod Energeticke Strojirenstvi). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The aims are discussed of the introduction of diagnostic systems for primary circuits of nuclear power plants. It is emphasized that the financial costs of the diagnostic system represent but a small part of the total costs of the nuclear power plant. Characterized are the methods used for signal detection, evaluation and processing, the composition of the measurement chain and the equipment for evaluating the obtained data. Briefly described are hardware and software of diagnostic systems in Czechoslovak nuclear power plants. The systems supplied to Czechoslovak power plants are not the final solution. Systems considered for future plants are to be enlarged not only as concerns the number of sensors but also with regard to the problem area monitored. (Z.M.).

45400 (INIS-mf—10947, pp 123) **Algorithmization of neutron noise measurement and evaluation in reactor diagnostics.** Vavrin, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

45401 (INIS-mf—10947, pp 124-131) **ANDAT - an interactive system for use in technical diagnostics of nuclear power plants.** Vosvrda, M.; Havlova, H. (Ceskoslovenska Akademie Ved, Prague. Ustav Teorie Informace a Automatizace). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The ANDAT program package is described which is designed for statistical analysis of data files and which provides the researcher with the advantages of a dialogue with the computer system. At present, that version has been completed which is generally oriented to applied spectrum analysis. Also under preparation is a version oriented to diagnostics in nuclear power plants. For this purpose the ANDAT system will be completed with segments for an analysis of the behaviour of estimates of spectral densities and spectra, as well as with decision-making nodes in dependence on the character of the spectrum. (Z.M.).

45402 (INIS-mf—10947, pp 7) **Research by VUJE of the diagnostics of nuclear power facilities.** Bahna, J.; Jaros, I. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 1986. (In Slovak). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

45403 (INIS-mf—10947, pp 16-22) **Investor's requirements on software of operating diagnostic system in period of nuclear power unit start-up.** Barak, M. (Jaderna Elektrarna, Dukovany, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The demands are summed up on the software for the diagnostic system of the Dukovany nuclear power plant in the period of the integrated hydraulic trial, the physical and power start-up of the unit. These demands have followed from experience gained with the first and second units of the plant which showed that it was very difficult to locate, using the installed diagnostic system, the source of the failure by analyzing an arbitrary signal from the sensor output. The functions are defined which the diagnostic system software must fulfil during the start-up when it is necessary to detect defects of delivered components including defects of assembly such as to allow their removal during the revision of the installation. Special attention is devoted to the identification of loose parts in the primary circuit and to the possibility of calibrating and simulating the system of loose parts in operation. The software of the system must proceed from an estimate of weight and kinetic energy of the loose part which must be identified, including the distance between the point of impact and the sensor, and the time of contact of the part with the point of impact. (Z.M.).

45404 (INIS-mf—10947, pp 31-48) **Hardware and software for the diagnostics of Czechoslovak nuclear units with WWER-440 and WWER-1000 reactors.** Drab, F.; Mlady, Z. (Skoda, Plzen, Czechoslovakia. Zavod Vystavba Jadernych Elektraren). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The hardware of in-service diagnostics of Czechoslovak nuclear units with WWER-440 reactors at present consist of a configuration of diagnostic systems for vibration control, control of loose parts and leakage control manufactured by the West German firm KWU, completed with a Czechoslovak computer type evaluation system. This system does not, however, have continuity with major Soviet made measurement systems and cannot therefore solve the whole range of diagnostic and expert problems. It will therefore be necessary to equip the WWER-440 units with subsystems for control system self-diagnostics, the reactor protection system, the diagnostics of the reactor core condition, etc. On the other hand, the concept of in-service diagnostics of the primary circuit of WWER-1000 units for the Temelin nuclear power plant according to the Soviet design is an integral component of the whole automated control system. The demands are defined placed on completing the structure of the automated system of secondary circuit control with technological equipment of Czechoslovak provenance. Briefly described are areas on which attention should be centred in case components of the primary circuit of WWER-1000 reactors are manufactured in Czechoslovakia. (Z.M.).

45405 (INIS-mf—10947, pp 60) **Software conception of in-service diagnostic systems of nuclear steam-generating facilities.** Grof, V. (Skoda, Plzen, Czechoslovakia. Zavod Energeticke Strojirenstvi). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

45406 (INIS-mf—10947, pp 61-70) **Final contractor's experience with putting into operation the software of in-service diagnostic systems of nuclear power plants.** Grof, V.; Huzl, V.; Vitous, J. (Skoda, Plzen, Czechoslovakia. Zavod Energeticke Strojirenstvi). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The first three WWER-440 units of the Dukovany nuclear power plant are provided with in-service diagnostic systems developed by SKODA, Czechoslovakia. The software for these systems fulfils the basic functions of the collection and processing of diagnostic signals. Characterized are the stage of the preparation of the computer system at the manufacturing plant and at the power plant, testing of parts of the system, its assembly and the verification of cooperation of special equipment such as buses, the multiplexer and the spectrum analyzer, with the ADT 4410 computer. Briefly summed up is experience with the development of individual program modules: the MUX program serving the multiplexer control, the DEMAN program for controlling the spectrum analyzer and the DGMN program which is designed for controlling the operation of all program modules. Program modules ZMEN, FASTM and SLOWM are designed for servicing the DASIO I/O unit and for fast and slow sampling of input analog signals. (Z.M.).

45407 (INIS-mf—10947, pp 71-85) **Operating reliability and diagnostics of nuclear facilities.** Hrbek, Z.; Kott, Z. 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The questions are discussed of the incorporation of diagnostic systems in the area of increased operating reliability and radiation safety of nuclear power plants. Under Czechoslovak conditions the diagnostic system for the primary circuit of WWER-440 reactors was additionally included in final deliveries of equipment by the SKODA enterprise. This system completes the system of reactor testing and control and may partly be used for the diagnostic processing of some of its signals. The diagnostic system for WWER-440 reactors as designed by SKODA incorporates the following methods and equipment: equipment for monitoring the vibrations of main components of the primary circuit, monitoring loose and loosened parts in the primary circuit, monitoring the acoustic field allowing to monitor the development of defects of mobile components including vibrating elements, detection of coolant loss, equipment for acoustic emission and for measurement of strain of critical parts of components of the primary circuit. (Z.M.).

45408 (INIS-mf—10947, pp 94-99) **Experience with operating ADT 4410 software in the in-service diagnostic system of unit 1 of Dukovany nuclear power plant.** Karmasin, K.; Mozor, B. (Jaderna Elektrarna, Dukovany, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The data evaluation unit of the in-service diagnostic system of the first unit of the Dukovany nuclear power plant is based on the ADT 4410 computer. The modifications are described of the software, namely of the DEMAN program module which is designed for communication between the spectrum analyzer and the computer. A reconfiguration has also been made of the operating system of the computer in order to be able to increase the capacity of disc memories. This will make it possible to use the software for the evaluation of experimental measurements and for filing data obtained from measurements on rotary machines in the nuclear power plant. (Z.M.).

45409 (INIS-mf—10947, pp 101) **Automated monitoring system for technical diagnostics.** Liska, J.; Dalik, F. (Skoda, Plzen, Czechoslovakia. Zavod Energeticke Strojirenstvi). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

45410 (INIS-mf—10947, pp 102) **In-service diagnostic system for Mochovce nuclear power plant.** Liska, J.; Dalik, F. (Skoda, Plzen, Czechoslovakia. Zavod Energeticke Strojirenstvi). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

45411 (INIS-mf—10947, pp 103-111) **Problems in calculating reactor model (primary circuit) for nuclear power plant diagnostics.** Markov, P. (Skoda, Plzen, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

Some results are presented of the calculation of eigen-vibrations of the system of WWER-440 nuclear reactor vessels in a vacuum and in a liquid. Computer code BOSOR 4 has been written for calculating forced vibrations of shells with axial symmetry and of a simplified system of reactor vessels. A description is given of this code, which is based on the so-called energy method of finite differences. Briefly discussed is the feasibility of applying the results of the latest computation techniques in the diagnostics of the major components of a nuclear reactor. (Z.M.).

45412 (INIS-mf—10947, pp 113) **Algorithms for in-service technical diagnostics of WWER type steam generators and pressurizers.** Matal, O.; Rybak, M.; Sirek, J.; Urbanek, M.; Banovec, J.; Konarik, M.; Sobotka, J. (Vyzkumny Ustav Energetickych Zarizeni, Brno, Czechoslovakia). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

45413 (INIS-mf—10947, pp 114-122) **Software conception of acoustic emission system for monitoring failure formation and propagation in material of primary circuit component.** Svetlik, M. (Skoda, Plzen, Czechoslovakia. Zavod Energeticke Strojirenstvi). 1986. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE87702905. (CONF-8606327—).

From Seminar on software for diagnostic systems of nuclear power plants; Plzen, Czechoslovakia (3 Jun 1986).

The subsystem for monitoring the formation and propagation of material defects of the primary circuit using the method of acoustic emission will be a relatively independent part of the system of in-service diagnostics at the Temelin nuclear power plant. The subsystem will, like the other subsystems, be able to communicate with the central computer. The individual conceptual problems are outlined of the software of the subsystem. The concept proceeds on the one hand from the possibilities of the testing instruments and on the other from the concept of the content and form of output data for the diagnostic system. A detailed list is given of demands on software with regard to the operation of the acoustic emission subsystem in the pressure test mode and in the mode of monitoring the condition of the material of the primary circuit, which differ substantially. (Z.M.).

45414 (NP—7900797, pp 13-16) **Reaction rate and control rod analysis in a large heterogeneous core ZPPR-13A.** Kawashima, Masatoshi; Yoshida, Tadashi; Yamamoto, Masaaki. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Power Reactor and Nuclear Fuel Development Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The ZPPR-13 program was a cooperative study between the US Department of Energy (DOE) and the Power Reactor and Nuclear Fuel Development Corporation of Japan (PNC). The program has been called "JUPITER-II." The goal of the program was to study the physics of radially heterogeneous core in the 650 MWe size range. The various assembly configurations in the program had common characteristics of a large central blanket, two internal blanket rings, three fuel rings, axial and outer radial blankets and surrounding reflectors. Core volumes (fuel zones only) were about 4000 liter and total fissile plutonium masses were about 2.5 tons. Table 1 shows the inter-comparison of the general features of the ZPPR-13 cores, as well as those of ZPPR-9 and -10A which were conventional homogeneous cores of 650 MWe class in the "JUPITER-I" program. This paper describes the flux-tilt effect observed through the initial analysis of the reaction rate and control rod experiments done in the first assembly in the ZPPR-13 series, ZPPR-13A, which had a simple quasi-cylindrical geometry. Figure 1 shows the core-blanket configuration of ZPPR-13A which had no sodium filled channels in the reference core.

45415 (NP—7900797, pp 55-56) **Experience of the Reactor Management System in load following operation.** Araki, Tsuneyasu; Kawamura, Atsuo; Yamamoto, Fumiaki; Tabata, Nobuyuki; Muto, Sakae; Nakano, Hideo. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.; Tokyo Electric Power Co., Inc., Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The Reactor Management System (RMS) is an onsite system with a minicomputer whose function is to perform detailed monitoring and prediction of the core status in order to make reactor operation more efficient and easier. The RMS had been in-plant-tested at Fukushima unit 3 (BWR) in Japan from 1977 to 1983. At this unit, load following operation was performed through Dec. 1982 to Jan. 1983 (total 5 cycles of daily load changes). In this operation, newly developed Reactor Power Regulator (RPR) system was used to keep the target load patterns by controlling recirculation flow rate and the RMS supplied very efficient core state data to operators and collected a large amount of valuable data.

45416 (NP—7900797, pp 64-65) **A computerized operator support system for BWR Power Plant (III): Structure of CRT pictures.** Monta, Kazuo; Sato, Nobuhide; Mori, Nobuyuki. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

A computerized operator support system for BWR power plant has been developed since 1980 supported by Japanese government. The main functions of the system are post trip operational guidance, disturbance analysis, standby system management, operational margin monitoring and control rod operational guidance. The former two functions aim at protection against incident during operation of nuclear power plants and the latter three functions aim at their prevention. As the final stage of the development, these functions are combined with plant supervision function and are organized as an advanced man-machine interface for BWR power plant. During above process, operator task analyses are performed to enable synthesis of these support functions for right fit to operator tasks and to realize a hierarchical structure for CRT displays for right fit to operators cognitive needs.

45417 (NP—7900797, pp 66-67) **An RHR operation guide system based on knowledge engineering.** Hattori, Yoshiaki, Itoh, Juichiroh; Kawamura, Atsuro. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Operating sequences of nuclear power plants are described in operation manuals. To facilitate for operators to perform these sequences, especially in abnormal situations, computerized operator supports are often desired. One approach of this solution is to output those manuals as operation guidance for operators on CRT displays. Another approach of dynamic operation guide is to search plant signals to identify plant status and to display adequate guide by means of newly developed computer technology. The authors developed a dynamic and flexible operation guide system based on knowledge engineering. This operation guide system can display guide messages relevant to any plant status. As the first step developing this operation guide system, operation guide for the mode selection of RHR (Residual Heat Removal) system in BWR plants was implemented on mini-computer by an off-line program.

45418 (NP—7900797, pp 68-69) **Loose-part location and mass estimation techniques.** Tsunoda, Tomio; Sano, Kenichi; Tsuneoka, Osamu; Morioka, Toshihiko; Kato, Toshiaki; Hirata, Kazuya; Sekido, Yoji; Sendai, Koichiro; Segawa, Motomichi; Yamatoku, Shinsai. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.; The Tokyo Electric Power Co., Inc.; Tohoku Electric Power Co., Inc.; The Chubu Electric Power Co., Inc.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

In nuclear power plants, a loose part, whether it be from a failed or weakened component or from an item inadvertently left in the primary system during construction, refueling, or maintenance procedures, can contribute to component damage and material wear by frequent impacting with other parts in the system. Thus, detection of loose parts is very important in plants, and information on the location and mass of the detected loose parts is necessary. Results of the studies to evaluate the location and mass of the loose parts are reported here.

45419 (NP—7900797, pp 93) **Extended NAIG MU-Gamma System.** (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The first NAIG MU-Gamma System has been in operation at Onagawa nuclear power station since August 1983. The second and the third systems have been in operation in the Fukushima No. 3 and Kashiwazaki No. 1 nuclear power stations respectively since August 1984. These systems have been developed for the purpose of analysis of radioactive wastes, and are composed of the NAIG E-series nuclear instrument system, including modules, mini-computers and softwares.

45420 (NP—7900797, pp 94-95) **NAIG Critical Assembly (NCA) Radiation Monitoring System.** (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The NCA Radiation Monitoring System, consisting of D-Series Monitor System, has been operated for more than 10 years and has now been remodeled into a new monitor system. The system is composed of 12 channels which are used for 4 channels of gamma area monitor, 2 channels of fast and thermal neutron area monitor, 1 channel of water and gas monitor, and 2 channels of

dust monitor. Each channel consists of Detector, Pre-Box (including HV and LV supply, Pre-Amp or Current to Freq. Converter, etc.), Log Ratemeter, and Alarm Logic. In this new Radiation Monitoring System, various newly developed features are employed. This report describes these new features.

45421 (NP—7900797, pp 96-97) **Wide range gamma dose ratemeter.** (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

A scintillation detector with high performance has been developed for 'NAIG E-series Monitor System.' In the gamma dose rate monitoring system, two types of detectors are employed usually; a NaI (Tl) scintillation detector is used for environmental level, and an ion-chamber is for higher level. This new instrument has more wide dynamic range both in dose rate and energy than any other scintillation detector, so that only one detector is capable to measure in any intensity of dose. In the range of dose rate up to 10 R/h, the instrument holds excellent linearity. In the energy-wide above 50 keV, it also keeps flat response. These characteristics above make this instrument to be effective for gamma-ray monitoring in any place, such as environmental monitoring post or "hot" area monitors in the nuclear power plant.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 45132, 45433, 45433, 45441, 45441, 45443, 45483, 45491

45422 **(KFK—4198) Investigations on the influence of combustion products on the retention of radioiodine by activated carbons.** Deuber, H.; Giraud, V. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 2). Apr 1987. 36p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-10828.

Investigations were performed on the influence of gaseous combustion products from relevant materials used in nuclear power plants on the retention of methyl iodide (CH/sub 3//sup 131/I) by commercial impregnated activated carbons. It is concluded that with iodine filters of large bed depths (residence time: ≧ 0.5 s), when containing a usually employed impregnated activated carbon, a sufficiently high retention of radioiodine should be achievable even with a high challenge of gaseous combustion products.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 45362, 45391, 45397, 45414, 45443, 45483, 45514, 45515

45423 **(HEDL-SA—3388-FP) The effect of swelling in Inconel 600 on the performance of FFTF [Fast Flux Test Facility] reflector assemblies.** Makenas, B.J.; Trenchard, R.G.; Hecht, S.L.; McCarthy, J.M.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1986. Contract AC06-76FF02170. 17p. (CONF-860605—46). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014366.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The Fast Flux Test Facility (FFTF) is designed with nonfueled outer row assemblies, each of which consists of a stack of Inconel 600 blocks penetrated by 316 stainless steel (SS) coolant tubes. These assemblies act as a radial neutron reflector and as a straight but flexible core boundary. During an FFTF refueling outage it was observed that the degree of difficulty in withdrawing an outer row driver fuel assembly was a function of the peak fast fluence of neighboring reflector assemblies. It was subsequently determined through various postirradiation examinations that the reflector assemblies were both bowed and stiff. Measurements of the individual Inconel 600 blocks indicated that the blocks had distorted into a trapezoidal cross section due to differential swelling of Inconel 600 in a steep radial flux gradient. Immersion density results indicate greater irradiation induced volumetric swelling than any previously reported data or correlation for Inconel 600 at equivalent fast fluence. The Inconel 600 swelled approximately the same amount as the SA 316 SS reflector components. Transmission electron microscopy studies on the Inconel blocks and swelling measurements on related materials have been performed and these data have been related to the performance of the reflector materials.

45424 **(HEDL-SA—3389-FP) Swelling of 316 stainless steel and D9 cladding in FFTF [Fast Flux Test Facility].** Makenas, B.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1986. Contract AC06-76FF02170. 11p. (CONF-860605—45). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014365.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

A data base of cladding swelling measurements from postirradiation examinations of FFTF 316 stainless steel clad fuel pins has been developed which is now sufficiently large to compare to previously published cladding swelling data. This comparison of data was motivated by the observation, in the early cycles of FFTF operation, that design swelling correlations had to be adjusted to account for the observed length increases of driver assembly ducts. These original correlations had been developed from nonfueled EBR-II irradiation tests. The recent data indicate that FFTF and EBR-II cladding, from actual fuel pins with similar heats of steel, behave almost identically with respect to fast fluence. The FFTF data further suggest that, above ~490°C, 316 stainless steel (SS) swells in a manner which is essentially independent of irradiation temperature. A comparison of immersion density measurements with the length increases for FFTF driver fuel pins has also shown the 316 SS cladding swelling behavior to be essentially isotropic. D9 cladding (a titanium modified variant of 316 SS) has also been irradiated in FFTF. The data base here is limited, but is large enough to establish the superiority of D9 over 316 SS as an FFTF fuel pin cladding from a swelling point of view.

45425 **(HEDL-SA—3422-FP) The in-reactor deformation of the PCA alloy.** Puigh, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1986. Contract AC06-76FF02170. 20p. (CONF-860421—79). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014382.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The swelling and in-reactor creep behaviors of the PCA alloy have been determined from the irradiation of pressurized tube specimens in the FFTF reactor. These data have been obtained to a peak neutron fluence corresponding to approximately 80 dpa in the FFTF reactor for irradiation temperatures between 400 and 750°C. Diametral measurements performed on the unstressed specimens indicate the possible onset of swelling in the PCA alloy for irradiation temperatures between 400 and 550°C and at a neutron fluence corresponding to ~50 dpa. The creep data suggest a non-linear fluence dependence and linear stress dependence (for hoop stresses less than 100 MPa) which is consistent with the in-reactor creep behavior of many cold worked austenitic stainless steels. These PCA creep data are compared to available 316 SS in-reactor creep data. The in-reactor creep strains for PCA are significantly less than observed in 20% cold worked 316 SS over the temperature ranges and fluences investigated.

45426 **(HEDL-SA—3514-FP) Remote tool development at the Interim Examination and Maintenance (IEM) cell.** Kalk, J.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76FF02170. 6p. (CONF-861102—48). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014371.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Tightening fasteners remotely in a hot cell can be a very exasperating experience. In many places, viewing is difficult and work sometimes must be done using mirrors and/or cameras for viewing. If electromechanical manipulators are used, the operator has no "feel", which often can result in broken equipment. At the Interim Examination and Maintenance (IEM) Cell, where reactor components from the Fast Flux Test Facility (FFTF) are disassembled,

several tools have been developed for tightening fasteners under these conditions. The philosophy used for this tool development is to use inexpensive commercially available tools with minimal modification for in-cell use. This philosophy was adopted after spending several years unsuccessfully trying to develop a special electric impact wrench.

45427 **(HEDL-SA—3625-FP) Integrated leak rate test of the FFTF [Fast Flux Test Facility] containment vessel.** Grygiel, M.L.; Davis, R.H.; Polzin, D.L.; Yule, W.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76FF02170. 6p. (CONF-870917—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014381.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

The third integrated leak rate test (ILRT) performed at the Fast Flux Test Facility (FFTF) demonstrated that effective leak rate measurements could be obtained at a pressure of 2 psig. In addition, innovative data reduction methods demonstrated the ability to accurately account for diurnal variations in containment pressure and temperature. Further development of methods used in this test indicate significant savings in the time and effort required to perform an ILRT on Liquid Metal Reactor Systems with consequent reduction in test costs.

45428 **(HEDL-SA—3633-FP) FFTF [Fast Flux Test Facility] management.** Bennett, C.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76FF02170. 8p. (CONF-870917—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014385.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

Fuel Management at the Fast Flux Test Facility (FFTF) involves more than just the usual ex-core and in-core management of standard fuel and non-fuel components between storage locations and within the core since it is primarily an irradiation test facility. This mission involves testing an ever increasing variety of fueled and non-fueled experiments, each having unique requirements on the reactor core as well as having its own individual impact on the reload design. This paper describes the fuel management process used by the Westinghouse Hanford Company Core Engineering group that has led to the successful reload design of nine operating cycles and the irradiation of over 120 tests.

45429 **FFTF/IEM cell fuel pin weighing system - remote maintenance design considerations.** Gibbons, P.W. (Westinghouse Hanford, Richland, WA). *Transactions of the American Nuclear Society;* **53**: 512-514(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The interim examination and maintenance (IEM) cell in the Fast Flux Test Facility (FFTF) is used for remote disassembly of irradiated fuel and material experiments. For those fuel experiments where the FFTF tag-gas detection system has indicated a fuel pin cladding breach, a fuel pin weighing system is needed to detect the reduced weight of an individual pin due to the escape of fission gases. Such as system has recently been developed for use in the IEM cell. The weighing machine, supporting equipment, and mounting and transfer systems are described.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 45110, 46982

45430 **(UNI-SA—201) Spent fuel critical masses and supportive measurements.** Toffer, H.; Wells, A.H. (UNC Nuclear Industries, Inc., Richland, WA (USA); Nuclear Assurance Corp., Norcross, GA (USA)). 22 Jun 1987. Contract AC06-76RL01857. 5p. (CONF-871045—5). NTIS, PC A02. File Number DE87012227.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

Critical masses for spent fuel are larger than for green fuel and therefore use of the increased masses could result in improved handling, storage, and transport of such materials. To apply spent fuel critical masses requires an assessment of fuel exposure and the corresponding isotopic compositions. The paper discusses several approaches at the Hanford N Reactor in establishing fuel exposure, including a direct measurement of spent to green fuel critical masses. The benefits derived from the use of spent fuel critical masses are illustrated for cask designs at the Nuclear Assurance Corporation.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 45375, 45376, 45379, 45555, 46188, 46286, 46982

45431 **(BMU—1986-132) Examination of methods of analysing structural dynamics for their applicability in licensing procedures. Recent experience, results, and trends concerning the seismic load conditions.** Gruner, P.; Jonczyk, J.; Schulz, H. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1986. 104p. (In German). (GRS-A—1229). NTIS, PC E11; Available from NTIS as TIB/B87-10623.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

It was common practice up to now to provide design-based protection against relatively rare load conditions (external impacts/internal impacts), and this approach frequently made the design solutions for mechanical equipment look rather oversized. Many experiences with real seismic events, probabilistic risk analyses, experimental studies, and the Seismic Safety Margins Research Program (SSMRP) carried out in the U.S.A. have proven this. The report in hand presents assessments and evaluations concerning the following topics: Trends in the design tensile load safety of mechanical plant components, component behaviour under seismic loads, results of the SSMRP, application of inelastic spectra, damping design concept for pipework and failures of impact absorbing elements in pipework. Proposals are presented for a modified approach and redefinition of requirements.

45432 **(CONF-871045—3) The United States Department of Energy Office of Nuclear Safety national criticality safety program and activities.** Barber, R.W.; Brown, B.P.; Hopper, C.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011662.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

The United States Department of Energy (DOE) Office of Nuclear Safety (ONS) is responsible for formulating Departmental nuclear safety policy and for over viewing the implementation of the policy by the DOE Program Offices. Since nuclear criticality safety is an issue of paramount importance to the DOE, the ONS continues to pursue a coherent criticality safety program by coordinating current activities and future initiatives which will build upon past accomplishments. This paper provides a brief historical background of the evolution and structure of the US Department of Energy Office of Nuclear Safety since 1981, a review of recent outlay programs and a preview of the planned DOE ONS activities.

45433 **(CONF-8508150—Summs.) Proceedings of the workshop on intrinsically safe and economical reactors.** Livingston, R.S. (Oak Ridge Associated Universities, Inc., TN (USA); Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.). Dec 1985. Contract AC05-76OR00033. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

This report presents the proceedings of a workshop concerning the design of inherently safe reactors. This paper emphasizes

Japanese contributions to this subject, especially small reactors. Nine analytics were prepared for this report. (JDH)

45434 (CONF-8508150—Summs., pp 7-31) **Concepts of intrinsic safety.** Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

A newly introduced Japanese reactor concept, ISER (Intrinsically Safe and Economical Reactor), is intended to be a reference intrinsically safe light water reactor. ISER is designed similarly to PIUS but with greater economy in mind such that any utility in any country can choose it for its power system. Social assimilation and acceptability in the Asia Pacific Region including the United States are the keys to the ISER with the hope of dramatic reductions of social costs due to safeguards, reliability, financiability, and infrastructure building, particularly in the third world, as well as reactor safety itself. In this respect and others, the ISER proposal is different from other vendor-proposed reactor concepts and is unique.

45435 (CONF-8508150—Summs., pp 93-103) **Small intrinsically safe reactor implications.** Wakabayashi, Hiroaki. (Tokyo Univ., Tokai, Ibaraki, Japan). Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

Reviewing the history of nuclear power, it is found that peaceful uses of nuclear power are children of the war-like atom. Importance of special growth in a shielded environment is emphasized to exploit fully the advantages of nuclear power. Nuclear power reactors must be safe for their assimilation into society from the points of view of both technology and social psychology. ISR/ISER is identified as a missing link in the development of nuclear power reactors from this perspective and advocated for international development and utilization, being unleashed from the concerns of politicization, safety, and proliferation.

45436 (CONF-8508150—Summs., pp 105-123) **Potential attractiveness of modular reactors.** Yamaji, Kenji. (Central Research Institute of Electric Power Industry, Tokyo, Japan). Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

During the period of the high economic growth, the electric utilities developed, through the pursuit of economies of scale, to form a typical heavy and huge industry. In the future, however, the electric utilities will be required to make a switchover to a more flexible and dynamic form of supply, due to slowing tempo of the demand growth, increasing uncertainty, stagnating economies of scale, bottlenecks of transmission, etc. In the light of such requirements of the times, there seems to be a need for a change in the development philosophy of the nuclear power generation, which field in the symbol of heaviness and hugeness. This paper examines possibilities for altering the image of the conventional nuclear power technology by developing modular reactors which are economical even at small capacities and can be sited in urban areas just like the conventional thermal power plants.

45437 (CONF-8508150—Summs., pp 125-134) **A conceptual design of intrinsically safe and economical reactor (ISER).** Oda, Junro. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

The purpose of this paper is to describe the reference conceptual designs of the ISER which were prepared for the ISER development forum in Japan. At the forum, participants from influential utilities, academia, as well as companies in the nuclear industry, discussed the development of the inherently safe reactor over the last two years. The conceptual designs described in this paper are preliminary trial designs at an early stage and essentially versions of the PIUS reactor developed by ASEA-ATOM. A notable feature of the ISER which is different from the original PIUS is its use of a steel reactor pressure vessel for reducing plant construction costs and improving plant performance.

45438 (CONF-8508150—Summs., pp 135-149) **Barge mounter ISER [intrinsically safe and economical reactor].** Kuwahara, Shin-ichi. (Hitachi Zosen Corp., Tokyo, Japan). Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

A forum in Japan has developed a new nuclear power plant ISER, a modified version of PIUS. ISER employs a conventional steel pressure vessel instead of PCRV used in the PIUS, thus allows the barge-mounted plant. This document introduces the concept of the barge-mounted ISER with its construction and siting.

45439 (CONF-8508150—Summs., pp 151-159) **Nuclear design of ISER [intrinsically safe and economical reactor].** Yamano, Naoki; Yokoyama, Takashi. (Nuclear Fuel Industries, Ltd., Osaka, Japan). Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

A preliminary core design work on ISER (Intrinsically Safe and Economical Reactor) based on the concept of the PIUS reactor of ASEA-ATOM is performed in order to grasp the characteristics of the reactor core and the fuel management scheme. Certain relations between the fuel specifications and the cycle length are estimated. Items of improvement on the ISER core characteristics and problems to be considered on the nuclear design are presented. Experiments to be considered are also discussed in conjunction with the development of experimental reactor (ISER-E).

45440 (CONF-8508150—Summs., pp 161-182) **Main pump trip response of PIUS [process inherent ultimate safety].** Asahi, Yoshiro; Yamanaka, Kazuo; Wakabayashi, Hiroaki. (Japan Atomic Energy Research Institute, Tokai, Ibaraki; Nippon Kokan K.K., Yokohama, Japan; Tokyo Univ., Tokai, Ibaraki, Japan). Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

The pump trip accident of a PIUS (process inherent ultimate safety) reactor with a secondary system was investigated by using the plant dynamics analysis code THYDE-W. The calculation yielded basically the same results as the previous one without the detailed secondary system simulation. This work shows one of the very few examples of a transient calculation of a secondary system.

45441 (CONF-8508150—Summs., pp 183-193) **Water treatment for the ISER [intrinsically safe and economical reactor] plant.** Sugawara, Ichiro. Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

The ISER reactor assures inherent safety by causing the core, which is submerged in pool water containing a high boric acid concentration, to quickly shut down the nuclear reaction when overheating, pump trip or other problems occur. However, large quantities of pool water may cause difficulties in water quality control and waste management, resulting in higher costs. Therefore, the ISER as a total plant would not be publicly acceptable unless the water treatment and waste management system offer both safety balanced with reactor inherent safety, and economy counterbalanced by large quantities of pool water. This report clarifies the passive safety concept of possible waste treatment and management systems, and the ways to economically construct such facilities.

45442 (CONF-8508150—Summs., pp 195-208) **Strategies for development of intrinsically safe and economical reactors.** Wakabayashi, Hiroaki. (Tokyo Univ., Japan). Dec 1985. NTIS, PC A10/MF A01. File Number DE87004195.

From Workshop on inherently safe reactors in the Far East; Oak Ridge, TN, USA (14 Aug 1985).

ISER (Intrinsically Safe and Economical Reactors) is chosen as an example of Intrinsically Safe Reactor to find a prospective

way for smooth development through international cooperation. For this, a specific Forum and/or Consortium is proposed to be created during the course of the executive meeting to be held at IEA (ORAU), Oak Ridge, Tennessee, 1985. Drawing from the experiences held in the past year in Tokyo, expansion of the Tokyo Forum into the International Forum is proposed.

45443 **(CONF-8709119—1) Comparison of computer code calculations with experimental results obtained in the NSPP series of experiments.** Tobias, M.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014416.

From Workshop on water-cooled reactor aerosol code evaluation and uncertainty assessment; Brussels, Belgium (9 Sep 1987).

Experiments were done on several aerosols in air atmospheres at varying temperatures and humidity conditions of interest in forming a data base for testing aerosol behavior models used as part of the process of evaluating the "source term" in light water reactor accidents. This paper deals with the problems of predicting the observed experimental data for suspended aerosol concentration with aerosol calculational codes. Comparisons of measured versus predicted data are provided.

45444 **(DOE/NE/37965—T1) Application of artificial intelligence to the operation of nuclear power plants: Progress report, September 15, 1986-June 4, 1987.** Hazek, B.K.; Miller, D.W. (Ohio State Univ. Research Foundation, Columbus (USA)). Jun 1987. Contract AC02-86NE37965. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010749.

This report summarizes progress to date on Department of Energy grant No. AC02-86N37965. Work began on this project September 15, 1986, and is scheduled to be completed December 31, 1987. The project has five major goals: combining two previously designed knowledge based systems; evaluation and selection of operational scenarios for testing and demonstration, evaluation and selection of a demonstration site; arrangement of an alliance with an industrial collaborator; and evaluation and specification of hardware and software requirements for connection to a full function simulator. Two papers delivered at the EPRI Seminar on Expert Systems Applications in Power Plants in May 1987, form a part of this report. In addition, two other paper summaries are included providing greater detail and updating development progress. These four individual papers have been cataloged separately. (FI)

45445 (DOE/NE/37965—T1, pp vp, Paper 1) **Expert system application to fault diagnosis and procedure synthesis.** Hajek, B.K.; Hashemi, S.; Bhatnagar, R.; Miller, D.W.; Stasenko, J. Jun 1987. NTIS, PC A03/MF A01. File Number DE87010749.

In Application of artificial intelligence to the operation of nuclear power plants: Progress report, September 15, 1986-June 4, 1987.

Two knowledge based systems have been developed to detect plant faults, to validate sensor data in a nuclear power plant, and to synthesize procedures to assure safety goals are met when a transient occurs. These two systems are being combined into a single system through a Plant Status Monitoring System (PSMS) and a common data base accessed by all the components of the integrated system. The system is designed to sit on top of an existing Safety Parameter Display System (SPDS), and to use the existing data acquisition and data control software of the SPDS. The integrated system will communicate with the SPDS software through a single database. This database will receive sensor values and equipment status indications in a form acceptable to the knowledge based system and according to an update plan designed specifically for the system.

45446 (DOE/NE/37965—T1, pp vp, Paper 2) **CSRL application to nuclear power plant diagnosis and sensor data validation.** Hashemi, S.; Punch, W.F. III; Hajek, B.K. Jun 1987. NTIS, PC A03/MF A01. File Number DE87010749.

In Application of artificial intelligence to the operation of nuclear power plants: Progress report, September 15, 1986-June 4, 1987.

During operational abnormalities, plant operators rely on the information provided by the plant sensors and associated alarms. The sensors' usefulness however, is quickly diminished by their large number and the extremely difficult task of interpreting and comprehending the provided information. Malfunction diagnosis can be further complicated by the existence of conflicting data which can lead to an incorrect diagnostic conclusion. Thus, the value of an operator aid to assist plant personnel in interpreting the available data and diagnosing the plant malfunctions is obvious. Recent work at the Ohio State University Laboratory for Artificial Intelligence Research (OSU-LAIR) and the Nuclear Engineering Department has concentrated on the problem of performing expert system diagnosis using potentially invalid sensor data. Expert systems have been developed that can perform diagnostic problem solving despite the existence of some conflicting data in the domain. This work has resulted in enhancement of a programming tool, CSRL, that allows domain experts to create a diagnostic system that will be, to some degree, tolerant of bad data. The domain of Boiling Water Nuclear Power Plants was chosen as a test domain to show usefulness of the ideas under real world conditions.

45447 (DOE/NE/37965—T1, pp vp, Paper 3) **An expert system for sensor data validation and malfunction detection.** Hashemi, S.; Hajek, B.K.; Miller, D.W.; Chandrasekaran, B.; Punch, W.F. III. Jun 1987. NTIS, PC A03/MF A01. File Number DE87010749.

In Application of artificial intelligence to the operation of nuclear power plants: Progress report, September 15, 1986-June 4, 1987.

During recent years, applications of expert systems in different fields of engineering have been under study throughout the world. At the Ohio State University, the theories developed by the Laboratory for Artificial Intelligence Research (LAIR) have been implemented for nuclear power plants and chemical processing systems. For nuclear power plants, these techniques have been further developed to reach diagnostic conclusions about malfunctions and faulty sensors, as well as to suggest corrective actions about the malfunctions. This paper concentrates on the AI applications to plant diagnosis and faulty sensor identifications. To achieve the above goals without adding extra sensors in a plant, the use of unlike sensor data (such as relationships between pressure and temperature in a Boiling Water Reactor (BWR)) and diagnostic conclusions about malfunctions as backups for suspicious sensors has been made. This extra evidence is readily available throughout the plant and is not generally used to backup suspicious sensor data in any manner.

45448 (DOE/NE/37965—T1, pp vp, Paper 4) **The structure of an expert system to diagnose and supply a corrective procedure for nuclear power plant malfunctions.** Hajek, B.K.; Stasenko, J.E.; Hashemi, S.; Bhatnagar, R.; Yamada, N.; Punch, W.F. III. Jun 1987. NTIS, PC A03/MF A01. File Number DE87010749.

In Application of artificial intelligence to the operation of nuclear power plants: Progress report, September 15, 1986-June 4, 1987.

Two prototype knowledge based systems have been developed at the Ohio State University. These systems were the result of collaboration between the Nuclear Engineering Program and the Laboratory for Artificial Intelligence Research (LAIR). The first system uses hierarchical classification to diagnose malfunctions of the coolant system in a General Electric Boiling Water Reactor (BWR). The second system provides a plan of action, through a process of dynamic procedure synthesis, to stabilize the plant once an abnormal transient has occurred. The objective of this paper is to discuss a structure that will integrate the two systems. The combined system will be capable of informing plant personnel about the nature of malfunctions, and of supplying to the operator the most direct corrective procedure available. Two important features of the integrated system are faulty sensor detection, based on malfunction context and unlike sensor data, and procedure synthesis based on the initial state of the plant.

45449 (EPRI-NP—5054-SR, pp 1.3-1.20) **Importance of core/concrete interactions for German risk investigations and experimental verification.** Rohde, J.; Hicken, E.F.; Friederichs, H.G.; Schroedl, E. (Gesellschaft fuer Reaktorsicherheit mbH, Koeln, West Germany). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The relevance of Molten Core Concrete Interactions (MCCI) for risk oriented investigations of German LWR-plants is evaluated. The problems of MCCI have been intensely investigated since the mid seventies in connection with the German Risk Study, Phase A and B on PWR plants of German design. Many examinations of both theoretical and experimental nature have led to the development of computer codes like WECHSL. The basis for verification is the internationally well accepted BETA experiment. Code WECHSL and the knowledge gained from the BETA experiment have been applied for the final investigations in German Risk Study, Phase B. Knowledge gained will be illustrated and its importance MCCI for German LWR-concepts will be shown.

45450 (EPRI-NP—5054-SR, pp 1.21-1.34) **Principal issues and EPRI research work on core debris/concrete interactions.** Sehgal, B.R.; Ritzman, R.L.; Vogel, R.C. Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The ex-vessel progression of a postulated core melt-down accident leads to molten corium concrete interactions (MCCI), during which the gases generated from concrete decomposition react with the corium melt. Fission product and reactant-material release and aerosol formation occur due to vaporization-condensation processes. The timing, the magnitude and the chemical and physical form of the products of MCCI are extremely important in determining the overall source term resulting from postulated severe accidents. Recent risk estimates of certain BWR accident scenarios have indicated that the source term emanating from MCCI dominates the calculated risks. The physics and chemistry of the MCCI is very complex and not well understood. In this paper, they highlight the principal technical issues, which they believe need clarification and resolution through experimentation and validated analyses.

45451 (EPRI-NP—5054-SR, pp 1.35-1.48) **UKAEA program on core debris - concrete interactions.** Turland, B.D.; Smith, P.N. (UKAEA, Abingdon, England). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The UKAEA is carrying out theoretical studies on the interaction of core debris with concrete, and its effect on containment loading and source term determination for severe accidents. The paper describes the current context and status of these studies. It also provides a summary of the work performed so far, including some earlier experimental studies.

45452 (EPRI-NP—5054-SR, pp 1.49-1.54) **United States Nuclear Regulatory Commission research program on core debris/concrete interactions and ex-vessel fission-product release.** Burson, S.B. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The study of core debris/concrete interaction phenomena has been a significant element of the NRC's Severe Accident Research Program for a number of years. The CORCON and VANESA codes used to predict the consequences of high-temperature debris attack on concrete and fission-product aerosol release are state-of-the-art computational tools. The major thrust of current NRC sponsored research focuses on the refinement, verification, and validation of these codes. An overview of the analytical and experimental aspects of the NRC research program is presented.

45453 (EPRI-NP—5054-SR, pp 1.55-1.64) **Program for LMFBR severe accident analysis including debris/concrete interaction at PNC, Japan.** Miyake, O.; Shimano, K.; Hiroi, H.; Himeno, Y. (Power Reactor and Nuclear Fuel Development Corp., Japan). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The ex-vessel event of LMFBR consists of a number of complex phenomena, and differs from that of LWR in the way of that LMFBR uses sodium as its coolant material. In particular, analyses of the core debris behavior should be treated carefully in the LMFBR melt through scenario, since the sodium pool fire and the sodium-concrete reaction could take place even though the debris is likely coolable. The long-term energy balance between decay heat and heat losses determines the sodium boil-dry and resulting debris-concrete interaction. In this paper the importance of the debris-concrete interaction in LMFBRs is examined.

45454 (EPRI-NP—5054-SR, pp 2.3-2.15) **BETA experimental results on melt/concrete interaction: silicate concrete behavior.** Alsmeyer, H.; Hagen, S.; Oehmann, M.; Skokan, A.; Schoeck, W.; Ruhmann, H. (Kernforschungszentrum Karlsruhe, West Germany). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

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The BETA-experiments investigate the melt/concrete interaction in a large scale melt facility using simulated core melts with internal heating. The experiments cover a wide temperature range from $> 2{,}000°C$ to the freezing temperatures of the melt. Melt front propagation and heat transfer rates are found to be strongly dependent on the temperature of the melt and on the existence of crusts possibly formed in the melt at the melting concrete surface. For high temperature liquid melts, fast downward propagation of the melt determines the cavity shape, and the very high downward heat transfer causes rapid drop of melt temperature, even for very high internal heating of the melt. Aerosol and gas release and material behavior are discussed. The experiment are used for code verification to allow application to the reactor core melt down accident.

45455 (EPRI-NP—5054-SR, pp 2.17-2.28) **BETA experimental results on melt/concrete interaction: limestone concrete behavior.** Alsmeyer, H.; Hagen, S.; Oehmann, M.; Skokan, A.; Schoeck, W.; Ruhmann, H. (Kernforschungszentrum Karlsruhe, West Germany). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Within the BETA test series, 3 experiments with limestone and limestone/common sand concrete have been carried out. The high gas release, dominated by CO and CO_2 rates, established a dispersion of the steel into the oxidic melt. The fast drop of the temperature of the melt indicates a very effective heat transfer, similar to silicate concrete behavior. The decarboxylation of the limestone is discussed with the possible influence on melt front propagation and aerosol release. Aerosols, observed in high concentration in the pure limestone experiment and in low concentration in the lime/common sand experiment, are mainly CaO crystals and are attributed to the process of lime burning.

45456 (EPRI-NP—5054-SR, pp 2.29-2.38) **Gas release measurement at the BETA-experiments on melt/concrete interaction.** Ruhmann, H.; Peehs, M. (Kraftwerk Union Aktiengesellschaft, Erlangen, West Germany). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

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In the BETA experiments simulated core melt/concrete interaction is investigated in a large scale test facility. The off-gas composition is determined by the thermal decomposition of concrete and the reaction of the released gases with the metallic melt. Gases produced during melt interaction with silicate concrete, immediately after pouring down the melt, consists of hydrogen (50-60%), water (30-50%), carbon monoxide (8-10%), carbon dioxide (3-5%) and traces of methane. On interaction with calcareous concrete the main components are CO_2, CO, H_2O (30%), H_2 (15%) besides small amounts of methane (1%). The values in brackets are typically found. Unsaturated hydrocarbons were present only in amounts near the detection limit (0.01%). Thermodynamic calculations were performed: at the beginning of the experiments, released gases are in equilibrium. This is valid for both kinds of concrete investigated. After the initial phase of the experiments the found composition deviate from equilibrium.

45457 (EPRI-NP—5054-SR, pp 2.39-2.42) **Sustained uranium-concrete interactions: the SURC experiments.** Copus, E.R.; Blose, R. (Sandia National Labs., Albuquerque, NM). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—). Contract AC04-76DP00789.

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The Ex-vessel Core Debris Interactions Program is designed to measure, model, and assess the thermal gas evolution, and aerosol source terms produced as a consequence of core-concrete interactions. These source terms are the governing phenomena in any post accident containment integrity evaluation or risk consequence analysis. A matrix of six tests is being executed as part of the Ex-vessel Program. This matrix is designated as the SURC (SUSTAINED URANIA-CONCRETE) test series.

45458 (EPRI-NP—5054-SR, pp 2.43-2.51) **Mixing of the oxidic and metallic phases due to gas bubble transport.** Suter, A.; Yadigaroglu, G. (Swiss Federal Institute of Technology, Zurich). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The spatial distribution of the oxidic and metallic phases during core/concrete interactions depends on the rate of gas generation due to the decomposition of the concrete. At high bubble transport rates the phases are likely to be mixed, while stratification may occur otherwise. A simple experimental setup and simulation fluids were used to investigate the details of the phenomena taking place when bubbles traverse the interface between two immiscible fluids. A series of movies allowed identification of the mixing mechanism. The outline of a simple analytical model using this information is also given.

45459 (EPRI-NP—5054-SR, pp 2.53-2.64) **Experimental study of pool entrainment and mixing between two immiscible liquids with gas injection.** Gonzalez, F.; Corradini, M.L. (Univ. of Wisconsin, Madison). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Void fraction as a function of superficial gas velocity in several liquids was obtained experimentally and compared to current models. Mixing if immiscible liquid pairs by gas injection was also studied experimentally. Results show that mixing should be considered at early times in molten core concrete interactions when high gas flow rates are predicted and at later times when the density ratio of the oxidic and to metallic layers is close to 1.0.

45460 (EPRI-NP—5054-SR, pp 3.3-3.6) **Aerosol and gas release source terms due to the interaction of hot, solid core-debris with concrete.** Copus, E.R. (Sandia National Labs., Albuquerque, NM). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—). Contract AC04-76DP00789.

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The purpose of the Hot Solid Program is to measure, model and assess the thermal, gas evolution, and aerosol source terms produced as a consequence of hot-solid core/concrete interactions. A matrix of five tests is being executed as part of the Hot Solid Program. This matrix is designated as the HS test series. Three HS tests have already been performed. HS-1 and HS-2 used mild steel as the hot solid material. The third test, HS-3, used a mixture of 70% UO_2 - 30% ZrO_2 as the hot solid. The two remaining tests, HS-4 and HS-5, will use UO_2 - ZrO_2 and a mixture of UO_2 - ZrO_2 with steel, respectively, as the core debris simulant. All of the HS tests are being conducted using limestone-common sand concrete base mats and are instrumented to measure thermal response, aerosol release, gas production, concrete erosion, and water release. Preliminary results from the first three HS tests indicate that (1) the thermal response of limestone common sand concrete is similar for steel core debris and UO_2-ZrO_2 core debris, (2) H_2, H_2O, CO, and CO_2 gases are released before, during, and after concrete ablation in flux amounts up to 30 kg/(m^2-hr), (3) H_2/H_2O and CO/CO_2 ratios correspond to equilibrium ratios for temperatures ranging from 600°K to 1400°K, (4) aerosols are also produced before, during and after concrete ablation in densities up to 10 g/m^3, and (5) collected aerosol samples contain both concrete and hot solid debris constituents.

45461 (EPRI-NP—5054-SR, pp 3.7-3.24) **Fission product release from core-concrete melts.** Tetenbaum, M.; Fink, J.K.; Johnson, C.E.; Ritzman, R.L. (Argonne National Lab., IL). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Based on measurements with a He-H_2O carrier gas, release fraction values for lanthanum, barium, and strontium gaseous fission product species have been obtained from small-scale core-concrete metals at 2150 and 2385 K. The sample configuration consisted of a layer of limestone or basaltic concrete granules, a layer of urania fuel granules containing La_2O_3, BaO, and SrO in solid solution, and a metal layer consisting of a mixture of stainless steel and Zircaloy between the fuel and concrete. The following trends in fission product release fraction values were found: Ba > Sr > La. Release fraction values based on measured release of fuel, cladding, structural, and concrete species are presented.

45462 (EPRI-NP—5054-SR, pp 3.25-3.57) **EPRI/ANL investigations of MCCI phenomena and aerosol release.** Spencer, B.W.; Gunther, W.H.; Armstrong, D.R.; Thompson, D.H.; Chasanov, M.G.; Sehgal, B.R. (Argonne National Lab., IL). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

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A program of laboratory investigations has been undertaken at Argonne National Laboratory, under sponsorship of the Electric Power Research Institute, in which the interaction between molten core materials and concrete is studied, with particular emphasis on measurements of the magnitude and chemical species present in the aerosol releases. The experiment technique used in these investigations is direct electrical heating in which a high electrical current is passed through the core debris to sustain the high-temperature melt condition for potentially long periods of time. In the scoping ex-

periments completed to date, this technique has been successfully used for corium masses of 5 and 20 kg, generating an internal heating rate of 1 kw/kg and achieving melt temperatures of 2000°C. Experiments have been performed both with a concrete base and also with a cooled base with the addition of H_2/CO sparging gas to represent chemical processes in a stratified layer. An aerosol and gas sampling system is being used to collect aerosol samples. Test results are now becoming available including masses of aerosols, X-ray diffraction, and scanning electron microscope analyses.

45463 (EPRI-NP—5054-SR, pp 4.3-4.14) **Improvements in CORCON heat transfer modeling.** Bradley, D.R.; Suo-Anttila, A.J. (Sandia National Labs., Albuquerque, NM). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—). Contract AC04-76DP00789.

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The CORCON computer code was developed at Sandia National Laboratories in order to model ex-vessel core debris - concrete interactions. Early comparisons between experimental data and CORCON calculations indicated that the existing melt-concrete heat transfer models were inadequate. An improved melt-concrete heat transfer model has been developed that consists of the Kutateladze nucleate boiling correlation acting in series with a melted slag film. Comparison of experiment results to calculations made using this model indicate good to excellent agreement for the TURC, SWISS and BETA tests that have been conducted at SNL and KfK.

45464 (EPRI-NP—5054-SR, pp 4.15-4.27) **Verification of the WECHSL code with the BETA experiments.** Reimann, M. (Kernforschungszentrum Karlsruhe, West Germany). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

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The BETA test series completed in February 1986 served for the purpose of verifying computer codes describing the interaction between a core melt and concrete structures, i.e. the WECHSL code developed at KfK. The physical modeling as well as the process of verification of this code is outlined in this paper. The capability of the code is demonstrated to reproduce experimental results with sufficient accuracy as well for tests with high power input and completely liquefied melt layers, as for tests with low power input where the heat transfer is governed by crust formation. The code can be utilized for upgrading from test scale to reactor scale. Some general conclusions for the behavior of a core melt or debris interacting with the concrete base mat are given.

45465 (EPRI-NP—5054-SR, pp 4.29-4.47) **Jet impingement phase of molten core-concrete interactions.** Sienicki, J.J.; Spencer, B.W. (Argonne National Lab., IL). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Scoping calculations have been carried out demonstrating that a significant and abrupt reduction in the corium temperature may be realized when molten corium drains as a jet from a localized breach in the RPV lower head to impinge upon the concrete base mat. The temperature decrease may range from a value of ~ 170 K (~ 140 K) for limestone (basaltic) aggregate concrete to a value approaching the initial corium superheat depending upon whether the forced convection impingement heat flux is assumed to be controlled by either thermal conduction across a slag film layer or the temperature boundary condition represented by a corium crust. The magnitude of the temperature reduction remains significant as the initial corium temperature, impinging corium mass, and initial localized breach size are varied over their range of potential values.

45466 (EPRI-NP—5054-SR, pp 4.49-4.66) **Experimental confirmation of the MAAP debris/concrete interaction model (DECOMP).** Sherry, R.; Fuller, E.L. (JAYCOR, San Diego, CA). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

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The Electric Power Research Institute (EPRI) is sponsoring a program at JAYCOR to verify and validate the MAAP (Modular Accident Analysis Program) (1) developed by the US IDCOR program. As part of this project, important phenomenological models in the MAAP code are being compared against physical experiments. An assessment of the models involved in predicting the characteristic behavior of core debris interacting with the reactor cavity concrete has been determined to be of high priority since the release of radionuclides after reactor vessel failure and the production of combustible gases is highly sensitive to the predicted interaction behavior. Furthermore, uncertainties associated with predicting such important parameters as melt temperature, crust thickness, interfacial heat transfer rates and gas generation rates are significant. Consequently, the MAAP core debris/concrete interactions model has been selected as the first MAAP model for verification and experimental validation. The paper will present the results of the validation analysis including an identification of the areas of agreement and disagreement between code prediction and experimental results and an assessment of the reasons for any significant differences.

45467 (EPRI-NP—5054-SR, pp 4.67-4.73) **High temperature regime of corium concrete interactions.** Ratnam, U.; Theofanous, T.; Pratt, W.T.; Hardin, W.B. (Univ. of California, Santa Barbara). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

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The high temperature regime of corium concrete interaction is examined from the point of view of its sensitivity to the completeness of reaction of the gaseous concrete decomposition products with the metallic components of the melt. A program based on the DECOMP modeling approach has been utilized for this purpose. For a corium/concrete heat transfer that is consistent with the erosion rates observed in the BETA experiments the primary effect of the extent of reaction completeness is on the duration of the high temperature regime. This implies a potentially important effect on the aerosols stripped out during this portion of the interaction.

45468 (EPRI-NP—5054-SR, pp 5.3-5.19) **Chemical phenomena and fission product behavior during core debris/concrete interactions.** Powers, D.A. (Sandia National Labs., Albuquerque, NM). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—). Contract AC04-76DP00789.

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The importance of chemical processes to the prediction of core debris interactions with concrete and associated aerosol generation are discussed. Some chemical processes that should be considered in improving existing models are described. Chemical processes could make the metal phase of core debris more dense than the oxide phase. Speciation of the melt can affect the apparent activity of melt constituents. Examples of speciation involving variable oxidation states and molecular aggregation are described. Consideration of silicate formation is shown to be unimportant for predicting barium release during core debris interactions with limestone concrete. Other chemical processes such as the effects of borate chemistry, vapor condensation and the effects of chlorides and sulfides are discussed briefly.

45469 (EPRI-NP—5054-SR, pp 5.21-5.31) **Ex-vessel fission product release modeling within integrated accident analysis.** Plys, M.G.; Kenton, M.A.; Henry, R.E. (Fauske & Associates, Inc., Burr Ridge, IL). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

A chemical equilibrium model for prediction of ex-vessel fission product release during core-concrete interactions is described. This model, called METOXA (Metals and Oxides Assumed in Equilibrium) is incorporated in the integrated severe accident analysis code MAAP. Results presented for PWR blackout (TMLB) sequences indicate that significant fractions of some fission products can be released from core debris. However, actual source terms depend greatly on the timing of containment failure, and substantial deposition of airborne fission products is shown to occur. Activity coefficients are shown to be important, especially for SiO_2 and alkaline earth oxides, and deserve experimental attention.

45470 (EPRI-NP—5054-SR, pp 5.33-5.47) **Vaporization of chemical species and the production of aerosols during a core debris/concrete interaction.** Butland, A.T.D.; Mignanelli, M.A.; Potter, P.E.; Smith, P.N. (UKAEA Winfrith, Dorchester, England). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The equilibrium chemical composition within gas bubbles sparging through isothermal molten corium-concrete mixtures has been evaluated theoretically. A series of sensitivity calculations gives some insight into a number of factors which are of importance in determining the radionuclide and non-radioactive releases during core-concrete interaction. The degree of mixing or layering of the pool has turned out to be of paramount importance in determining the magnitudes of the releases. The presence of unoxidized zirconium in the melt tends to enhance the release of a number of species and the type of concrete used for the base mat can have a significant effect. The predictions can be sensitive to the thermodynamic data used in the calculations. The vaporization of various species into the gas bubbles can require large amounts of heat; the loss of this heat from the melt can have an effect on the extent of the vaporization.

45471 (EPRI-NP—5054-SR, pp 5.49-5.60) **Aerosol decontamination factors in pools overlying molten core-concrete - code modeling.** Clough, P.N.; Ramsdale, S.A.; Smith, P.N. (UKAEA, Culcheth, England). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

BUSCA is a mechanistic computer code which models the removal of aerosol particles from a gas bubble as it rises through water. The thermal-hydraulic behavior of the bubble is also modeled, since this can strongly influence the aerosol removal processes, especially under condensing/evaporating conditions. BUSCA has been used to estimate possible decontamination factors (DF's) for a water pool overlying a region of molten core-concrete interaction. The DF is found to depend strongly on conditions in the melt. Strongly reducing conditions may lead to hydrogen bubbles, and result in negligible DF's, even in a subcooled pool.

45472 (EPRI-NP—5054-SR, pp 6.3-6.13) **Application of the core-concrete interaction code WECHSL to reactor case.** Cenerino, G. (Commissariat a l'Energie Atomique, Fontenay aux Roses, France). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The WECHSL code, developed at Kernforschungszentrum Karlsruhe, West Germany, is used for core melt accidents in nuclear power plants. The first calculations, considering silicate and limestone/common sand concretes of different compositions, analyze the influence of the initial mass of zirconium in the corium and, in one case, the effect of sump water ingression on the top of the melt. Moreover, for a limestone concrete, a sensitivity study is made on the melting temperature of the concrete influencing the decomposition enthalpy. The main conclusion of that paper is that, in any case, the temperature of the melt drops rapidly from the initial temperature to a temperature level close to the solidification temperature of the metal phase in a relatively short period of time (approximately 15 minutes) and then a balance between the removed heat from the melt and heating sources inside the melt is established.

45473 (EPRI-NP—5054-SR, pp 6.15-6.27) **Prediction of containment loads from the interaction of core debris with concrete.** Keeping, P.M.; Turland, B.D.; Brealey, N.J.; Young, R.L.D. (UKAEA, Abingdon, England). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Core debris interactions with concrete provide a load on the reactor containment, and a means of penetrating the containment. A new model is described that parameterizes current uncertainties in these interactions, and allows their effects on containment loading to be evaluated. More mechanistic evaluations of the containment loading should include a feedback from the conditions in the reactor cavity to the core-concrete interaction. This is investigated with CORCON-MOD2. In the long term, heat conduction into the base mat/ground will limit debris penetration; CORCON has been linked to a thermal conduction code to model the latter phases of the interaction.

45474 (EPRI-NP—5054-SR, pp 6.29-6.53) **Impact of heat transfer models on core/concrete interaction.** Kao, L.S.; Kazimi, M.S. (Massachusetts Institute of Technology, Cambridge). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

Analyses of the concrete attack and ex-vessel aerosol release using different heat transfer models for the molten corium/concrete interaction have been performed. The study involved variations in several parameters, such as initial debris temperature, amount of unoxidized Zr, amount of melt, concrete ablation temperature and the concrete type. At high initial corium temperatures the periodic contact (nucleate boiling like) model leads to more rapid concrete attack and higher fission product release than the gas film models. At low initial corium temperatures, when a corium crust is initially formed, the various heat transfer models do not lead to significant differences in the fission product releases. Besides the initial debris temperature, the most significant parameter in prediction of the fission product release was the amount of unoxidized Zr. Among the various fission products, the nonvolatiles, such as lanthanum, are more sensitive to changes in the parameters.

45475 (EPRI-NP—5054-SR, pp 6.47-6.53) **Effect of plant design on aerosol release from corium-concrete interaction.** Tsai, S.S.; Lutz, R.J. Jr.; Wooten, L.A. (Westinghouse Electric Corp.). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

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The plant design in the lower region of the containment, particularly the reactor cavity area, can significantly impact the ex-vessel generation of aerosol materials under severe accident conditions. Using the Millstone Unit 3 reactor cavity design, the CORCON code and the empirical correlation developed from the

Sandia tests were used to predict the rate of aerosol release from the core-concrete interaction in the reactor cavity. The results of the investigation show that: (i) the aerosol release rate and cumulative release increases with increasing reactor cavity floor area, and (ii) the amount of iron oxide present in the core melt has a dramatic impact on the aerosol release rate.

45476 (EPRI-NP—5054-SR, pp 6.55-6.67) **Potential risk related consequences of core-concrete interactions.** Burson, S.B.; Celestin, R.T.; Greene, G.A. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

In those severe-accident scenarios in which the primary vessel fails, high-temperature core debris falls into the reactor cavity where it interacts with structural concrete. This presentation outlines three aspects of core-concrete interaction analysis that must be considered in the prediction of radiological source terms: (1) the risk-related physical and chemical phenomena, (2) the NRC computer codes, CORCON and VANESA, used to predict the source-term and containment-loading parameters, and (3) possible causes of uncertainties in code predictions. Finally, to illustrate the range of problems encountered in determining code prediction uncertainties, a number of sensitivity studies and code comparisons with experimental data are reviewed.

45477 (EPRI-NP—5054-SR, pp 6.69-6.81) **CORCON-VANESA sensitivity study for Mark I BWR design.** Cybulskis, P. (Battelle Columbus Div., OH). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

The ex-vessel release of radionuclides, as calculated by the CORCON-VANESA portions of the Source Term Code Package, may dominate the predicted severe accident environmental source terms for Mark I BWR designs. The releases from corium-concrete interactions may take place in a failed drywell and may thus be available for release to the environment without passing through the suppression pool. Results of sensitivity studies on the dependence of predicted ex-vessel releases on input variations to CORCON-VANESA are presented.

45478 (EPRI-NP—5054-SR, pp 6.83-6.94) **Effects of lateral separation of oxidic and metallic core debris on the BWR MK I containment drywell floor.** Hyman, C.R.; Weber, C.F.; Hodge, S.A. (Oak Ridge National Lab., TN). Feb 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920306. (CONF-8609126—).

From Committee on the Safety of Nuclear Installations (CSNI) specialists' meeting on core debris/concrete interactions; Palo Alto, CA, USA (3 Sep 1986).

In evaluating core debris/concrete interactions for a BWR MK I containment design, it is common practice to assume that at reactor vessel breach, the core debris is homogeneous and of low viscosity, so that it flows through the pedestal doorway and spreads in a radially uniform fashion throughout the drywell floor. In a recent study performed by the NRC-sponsored Severe Accident Sequence Analysis (SASA) program at Oak Ridge National Laboratory, calculations indicate that at reactor vessel bottom head failure, the debris temperature is such that the debris metals (Zr, Fe, Ni, Cr) are completely molten while the oxides (UO_2 ZrO_2, FeO) are completely frozen. Thus, the frozen oxides are expected to remain within the reactor pedestal while the molten metals radially separate from the frozen oxides, flow through the reactor pedestal doorway, and spread over the annular region of the drywell floor between the pedestal and the containment shell. This paper assesses the impact on calculated containment response and the production and release of fission product-laden aerosols for two different cases of debris distribution: uniform distribution and the laterally separated case of 95% oxides-5% metals inside the pedestal and 5% oxides-95% metals outside the pedestal. The computer codes used are CORCON-MOD2, MARCON 2.1B and VANESA.

45479 (EPRI-NP—5338) **Radiation protection management program at TMI-2 [Three Mile Island]: Noteworthy practices and accomplishments: Final report.** Owen, D.E.; Brady, D.D.; Owrutsky, S.L. (Pentek, Inc., Coraopolis, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 62p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920564.

A successful dose reduction program must utilize disparate techniques such as sound technical understanding of contamination processes, through training in ALARA principles, management and worker commitment, and adequate tools. GPU Nuclear Corporation's cleanup program at TMI-2 represents a unique opportunity to test tools and techniques under real plant conditions not readily achieved in a laboratory. The dose reduction tools and techniques described herein have proven beneficial in the course of the accident cleanup. Each has potential for operating plant applications. This overview describes the problem that each technique was developed to address, how each tool was implemented, and how the implementation contributed to dose reduction.

45480 (GA-A—18888) **Safety and licensing of MHTGR [Modular High Temperature Gas Cooled Reactor].** Silady, F.A.; Millunzi, A.C.; Kelley, A.P. Jr.; Cunliffe, J. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1987. Contract AC03-84SF11963. 15p. (CONF-870863—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013934.

From Seminar on small and medium-sized nuclear reactors: safety and licensing issues; Lausanne, Switzerland (24 Aug 1987).

The Modular High Temperature Gas Cooled Reactor (MHTGR) design meets stringent top-level regulatory and user safety requirements that require that the normal and off-normal operation of the plant not disturb the public's day-to-day activities. Quantitative, top-level regulatory criteria have been specified from US NRC and EPA sources to guide the design. The user/utility group has further specified that these criteria be met at the plant boundary. The focus of the safety approach has then been centered on retaining the radionuclide inventory within the fuel by removing core heat, controlling chemical attack, and by controlling heat generation. The MHTGR is shown to passively meet the stringent requirements with margin. No operator action is required and the plant is insensitive to operator error.

45481 (GA-A—18930) **Probabilistic risk assessment of the modular high-temperature gas-cooled reactor.** Inamati, S.B.; Parme, L.L.; Silady, F.A. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1987. Contract AC03-84SF11963. 8p. (CONF-870820—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013933.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

A comprehensive safety risk assessment shows the Modular High-Temperature Gas-Cooled Reactor (MHTGR) to behave in an extraordinarily benign manner with only limited offsite releases predicted during even extremely unlikely accidents. By virtue of its high reliance on passive features inherent in the MHTGR, the overall safety of the concept is shown to be relatively insensitive to failures in active systems or operator actions.

45482 (GRS-F—159) **List of reports in the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reported period: January 1-March 31, 1987. Progress report.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). May 1987. 65p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10731.

This list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of reactor safety research. According to the cooperation of the Federal Minister for Research and Technology (BMFT) with the Commissariat a l'Energie Atomique (CEA), the Japan Science and Technology Agency (JSTA), the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission, these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The

list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programm of the BMFT, reporting organization. The list of reports appears quarterly.

45483 **(HEDL-SA—3569-FP) Radiological operating experience at FFTF [Fast Flux Test Facility].** Bunch, W.L.; Prevo, P.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76FF02170. 12p. (CONF-870405—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014378.

From Topical conference on theory and practice in radiation protection and shielding; Knoxville, TN, USA (22 Apr 1987).

The Fast Flux Test Facility has been in operation for approximately five years, including about one thousand days of full power operation of the Fast Test Reactor. During that time the collective dose equivalents received by operating personnel have been about two orders of magnitude lower than those typically received at commercial light water reactors. No major contamination problems have been encountered in operating and maintaining the plant, and release of radioactive gas to the environment has been minimal and well below acceptable limits. All shields have performed satisfactorily. Experience to date indicates an apparent radiological superiority of liquid metal reactor systems over current light water plants.

45484 **(INIS-mf—10659) 1985 annual report of the Nuclear Engineering Committee (KTA).** (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). 1986. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752470.

The Nuclear Engineering Committee (KTA) is charged with the establishment of safety regulations and has to provide for and control their application. 1985 saw the ratification of 4 regulations. 3 regulations were modified, 6 definite drafts and 3 drafts on the modification of regulations were presented. Ending 1985 KTA-regulations comprised 56 regulations, 13 drafts, 36 drafts in preparation and 8 preliminary reports. The 1985 annual report informs about the KTA activities, organization, administration and finances. (HSCH).

45485 **(INIS-mf—10938) Chernobyl and its consequences for Austria.** Schoenhofer, F.; Ecker, W.; Hojesky, H.; Junger, W.; Kienzl, K.; Nowak, H.; Riss, A.; Vychytil, P.; Zechner, J. (Bundesministerium fuer Gesundheit und Umweltschutz, Vienna (Austria)). Nov 1986. 249p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87703105.

First there is a short version of 16 pages. Then a detailed account is given mainly on the activities of the Federal Environment Office and the radiation burden to the population. The chapter headings are 1) The Chernobyl reactor accident 2) The meteorological situation 3) Monitoring of the radioactive contamination in Austria 4) Aims of the radiation measurement activities 5) Initial situation in Austria and first measurements 6) Environmental control 7) Food control 8) Fodder 9) Measures taken to minimise the radiation burden - a chronology 10) Comparison with nuclear tests fallout 11) Dose estimation 12) Radioactive contamination in other European countries. (G.Q.).

45486 (INIS-mf—10946, pp 1-8) **Environmental contamination related to the Chernobyl accident as measured in Israel during May-July 1986.** Schlesinger, T.; Biran, T.; Even, D.; Dukhan, R.; Shamai, Y.; Tal, A.; Friedman, K.; Koch, J.; Israeli, A. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

45487 (INIS-mf—10946, pp 9-15) **Radiation fallout and assessment of radiation dose to the population of southern Israel following the Chernobyl accident.** Laichter, Y.; German, U.; Levin, S.; Sberlo, E.; Knimah, N.; Naim, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

45488 **(NP—7900797) NAIG [Nippon Atomic Industry Group] annual review, 1984.** Inaba, Eiji (ed.). (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa. Nuclear Research Lab.). 1985. 103p. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

This is the eighth technical report published by the Nippon Atomic Industry Group Co., Ltd. (NAIG). This report contains results of research and development works performed by the NAIG Nuclear Research Laboratory during 1984. Technical papers in the areas of reactor physics, reactor engineering, and reactor chemistry are presented. Topic papers are presented on the following subjects: a boiling water reactor operation management system; development of a hollow fiber for liquid waste treatment; extended NAIG Mu-Gamma System, and the NAIG Critical Assembly (NCA) radiation monitoring system. A review of a wide range gamma dose ratemeter is also presented. Individual papers, topics, and reviews are cataloged separately. (FI)

45489 (NP—7900797, pp 57-59) **Analysis of ROSA-III large break test by TRAC-BD1.** Kato, Masami; Abe, Nobuaki; Aoki, Hideto; Tasaka, Kanji. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp., Japan Atomic Energy Research Institute). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

TRAC-BD1 code is a best estimate system code developed at the Idaho National Engineering Laboratory (INEL) for Boiling Water Reactor (BWR) loss-of-coolant accident (LOCA) analysis. This code features a three dimensional treatment of the BWR pressure vessel and a one-dimensional treatment of fuel bundles and pipings. The thermal hydrodynamic model is a nonhomogeneous, nonequilibrium two-fluid formulation for two-phase flow. The Rig of Safety Assessment (ROSA)-III test program at the Japan Atomic Energy Research Institute (JAERI) conducts the LOCA integral system experiment on a BWR. Run 926, which is a 200% guillotine break at the inlet side of a recirculation pump with assumption of HPCS failure, was analyzed by TRAC-BD1 to assess the predictive capability of the system behavior for a BWR during LOCA. The results are discussed in this paper.

45490 (NP—7900797, pp 62-63) **New safety analysis code assessment using ROSA-III test data.** Itoya, Seihiro; Aoki, Hideto. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

SAFER is a new safety analysis code which was developed under the cooperative efforts of Toshiba, Hitachi and General Electric. SAFER is a one dimensional thermal-hydraulic code for long term inventory analysis of boiling water reactors (BWRs) loss-of-coolant accident (LOCAs) as well as other off-normal reactor transients where neutron kinetics are of no consequence. SAFER has been assessed against a range of test data obtained from ROSA-III test facility, which simulates BWRs with jet pump component.

45491 (NP—7900797, pp 79-81) **Effects of weathering on impregnated charcoal removal efficiency for radioactive methyl iodide.** Shiomi, Hiromi; Yuasa, Yoshiyuki; Ohki, Masao. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

Standby Gas Treatment System (SGTS) which is one of the engineered safety features providing against reactor accident is installed in nuclear power stations. KI_3 impregnated charcoal (iodized charcoal) filter which is the element of SGTS is widely used for the removing of radioactive iodine species such as molecular iodine and methyl iodide. It is well known that the removal capability of impregnated charcoals for radioactive methyl iodide will deteriorate by various contaminants and humidity in flowing air through impregnated charcoals beds. This study is aimed at to grasp the effects of weathering on radioactive methyl iodide removal capability of iodized charcoals under the condition of Loss of Coolant Accident (LOCA) in BWR.

45492 (NP—7900797, pp 89-90) **TARMS [Toshiba Advanced Reactor Management System]: An on-line boiling water reactor operation management system.** Iwamoto, Tatsuya; Sakurai, Shungo; Tsuiki, Makoto; Makino, Kakuji. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The TARMS (Toshiba Advanced Reactor Management System) software package was developed as an effective on-line, on-site Boiling Water Reactor (BWR) core operation management system to increase operating flexibility and simplicity. It covers almost all the functional requirements to the current process computers to increase on-site core management capability, capacity factors, thermal margins, fuel reliability, and so on, by supporting application functions for: monitoring the present core power distribution; and aiding reactor operators and site engineers in making the core operation plans, by predicting future core performance. Highly accurate calculations for core performance estimation/prediction are performed in TARMS, with a high-speed, three-dimensional (3-D) BWR core physics simulator LOGOS2, which has an automated adaptation function to the in-core monitors. The verification of TARMS physics methods was successfully performed by using a large amount of plant data including those from gamma scannings.

45493 (NUREG—1185-Vol.1) **Integrated safety assessment report, Haddam Neck Plant (Docket No. 50-213): Integrated Safety Assessment Program: Draft report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 139p. NTIS, PC A07/MF A01 - GPO. File Number TI87900948.

The integrated assessment is conducted on a plant-specific basis to evaluate all licensing actions, licensee initiated plant improvements and selected unresolved generic/safety issues to establish implementation schedules for each item. Procedures allow for a periodic updating of the schedules to account for licensing issues that arise in the future. The Haddam Neck Plant is one of two plants being reviewed under the pilot program. This report indicates how 82 topics selected for review were addressed, and presents the staff's recommendations regarding the corrective actions to resolve the 82 topics and other actions to enhance plant safety. 135 refs., 4 figs., 5 tabs.

45494 (NUREG—1185-Vol.2-App.) **Integrated safety assessment report, Haddam Neck Plant (Docket No. 50-213): Integrated Safety Assessment Program: Draft report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1987. 712p. NTIS, PC A99/MF A01 - GPO. File Number TI87900949.

The operating history of the plant from 1967 through 1984 was reviewed and analyzed. The findings of the review identified trends and symptoms in the operating data that can be used as tools in the resolution and prioritization of the Haddam Neck safety issues. The review included evaluation of data collected on plant availability and capacity factors, forced shutdowns, power reductions, reportable events, and environmental considerations. The methodology used is also discussed. Data and information is presented in appendices. Haddam Neck Plant has generally been operated in a safe and orderly manner, with a trend that shows continuous improvement. Perturbations to this trend were correlated to an extensive turbine refit, post-effects of an extended operating run, and effects of efforts applied in response to TMI. Three specific symptoms of continuing safety related problems were recurrence of loss of offsite power events, control rod drive failures, and charging pump failures. 24 refs., 21 figs., 11 tabs.

45495 (NUREG/CP—0088) **Transactions of the 9th international conference on structural mechanics in reactor technology: Panel Session JK: Structural and mechanical engineering research at the United States Nuclear Regulatory Commission.** Browzin, B.S. (comp.). (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. 265p. (CONF-870812—). NTIS, PC A12/MF A01 - GPO. File Number TI87900888.

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

This volume provides information about the US Nuclear Regulatory Commission research directed toward safety issues, licensing, and information on related industry research. This report is directed primarily to seismic research. Ten analytics were prepared for this volume. (JDH)

45496 (NUREG/CP—0088, pp 21-49) **Seismic margins review of nuclear power plants: NRC program overview.** Murray, R.C.; Prassinos, P.G.; Ravindra, M.K.; Moore, D.L. (Lawrence Livermore National Lab., CA; EQE, Inc., Newport Beach, CA; Energy, Inc., Kent, WA). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

The US Nuclear Regulatory Commission is sponsoring a research program to develop and demonstrate a method for assessing safety margins at nuclear power plants with respect to seismic events. This program is called the Seismic Design Margins Program and was started in 1984 at the Lawrence Livermore National Laboratory. The need for this research results from the changing perception of the seismic hazard in certain localities which could require reassessment of the seismic design adequacy at some power plant sites. It is generally accepted that nuclear power plants are capable of withstanding earthquake motion substantially greater than their design basis, but methods are needed to systematically demonstrate this. An "Expert Panel on the Quantification of Seismic Margins" was formed to develop such a margins assessment method, and the method was applied to the Maine Yankee Atomic Power Station, a Combustion Engineering, three-loop pressurized water reactor located near Wiscasset, Maine. This paper highlights the methodology and emphasizes its application to Maine Yankee.

45497 (NUREG/CP—0088, pp 51-88) **Seismic capability of containments including pressure effects.** Amin, M.; Agrawal, P.K.; Ahl, T.J. (Sargent & Lundy, Chicago, IL; CBI Na-Con, Inc., Oak Brook, IL). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

A methodology for determining seismic capacity of containments subjected to prescribed pressure and thermal loads followed by a seismic excitation is presented. The application of methodology is described for four containments, for which a number of limit states are evaluated. Effects of soil-structure interaction, material nonlinearity, and uplift are considered. The evaluated capacities for two of the containments, in terms of peak horizontal ground accel-

eration, show that for all pressure and thermal loading conditions evaluated seismic capacity is significantly in excess of design safe shutdown earthquake level.

45498 (NUREG/CP—0088, pp 89-125) **Vibrational experiments at the HDR [Heissdampfreaktor]: German-US cooperation.** Kot, C.A.; Malcher, L.; Costello, J.F. (Argonne National Lab., IL; Kernforschungszentrum Karlsruhe, Federal Republic of Germany; US Nuclear Regulatory Commission, Washington, DC). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

As part of an overall effort on the validation of seismic calculational methods, the US Nuclear Regulatory Commission, Office of Research, is collaborating with the Kernforschungszentrum Karlsruhe, Federal Republic of Germany (FRG), in the vibrational/earthquake experiments conducted at the Heissdampfreaktor (HDR) Test Facility in Kahl/Main, FRG. In the most recent experiments (SHAG), high-level excitations were produced in the HDR facility by means of an eccentric-mass coastdown shaker capable of developing 1000 tons of force. The purpose was to investigate full-scale structural response, soil-structure interaction, and piping and equipment response. Data obtained in the tests serve to evaluate analysis methods. In the SHAG experiments, loadings of the HDR soil-structure system approached incipient failure levels as evidenced by high peak-accelerations and displacements, local damage, nonlinear behavior, soil subsidence, and wall strains that exceeded estimated limit values. Also, the performance of different pipe hanger configurations for the Versuchskreislauf (VKL) piping system was compared in these tests under high excitation levels. The support configurations ranged from very rigid systems (struts and snubbers) to very flexible configurations (spring and constant-force supports). 11 refs., 13 figs.

45499 (NUREG/CP—0088, pp 127-144) **Validation of seismic soil-structure interaction analysis techniques with Lotung experiment data: Overview of EPRI/NRC research program.** Tang, Y.K.; Kassawara, R.P.; Tang, H.T.; Wall, I.B.; Srinvasan, M.G.; Kot, C.A.; Hsieh, B.J. (Electric Power Research Institute, Palo Alto, CA; Argonne National Lab., IL). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

A large-scale seismic experiment facility has been constructed in Lotung, Taiwan, by the Electric Power Research Institute (EPRI) and Taiwan Power Company (Taipower). The objective of the experiment is to obtain actual seismic response data to validate soil-structure interaction analysis techniques. Eighteen earthquakes have been recorded at the site since the completion of the facility. A method validation program sponsored by EPRI, NRC (through Argonne National Laboratory, ANL), and Taipower has been initiated. The program involves blind prediction and result correlation of recorded responses for forced vibration tests and selected seismic events using various existing SSI methods. The results of the program expected to provide basis for a more realistic SSI practice for the industry.

45500 (NUREG/CP—0088, pp 145-156) **EPRI/NRC piping and fitting dynamic reliability program.** Guzy, D. (US Nuclear Regulatory Commission, Washington, DC). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Until recently, NRC and industry efforts to improve the overall "balance-of-design" of piping have concentrated mainly on reducing conservatisms associated with dynamic input loads and response calculation. Now it appears that revision of the ASME Code design criteria offers the best future alternative for improving piping design. The EPRI/NRC Piping and Fitting Dynamic Reliability Program will provide the principal justification for these changes. This paper gives an overview of this research program from an NRC perspective, and notes briefly how it relates to other NRC piping research and standards activities. 37 refs.

45501 (NUREG/CP—0088, pp 157-179) **Latest research results on seismic fragility data of nuclear power plant equipment.** Bandyopadhyay, K.K.; Hofmayer, C.H.; Kassir, M.K.; Pepper, S.E. (Brookhaven National Laboratory, Upton, NY). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

As part of the Component Fragility Research Program sponsored by the US Nuclear Regulatory Commission existing seismic fragility data for safety-related electrical and mechanical equipment used in nuclear power plants are collected and analyzed. The test results are presented for different equipment categories in the form of test response spectra which are useful for seismic margin studies. The data are also analyzed further and presented in the form of a single fragility descriptor for each equipment category for direct application in probabilistic risk assessments. The equipment categories discussed in this paper include motor control centers, switchboards, panelboards, and power supplies.

45502 (NUREG/CP—0088, pp 181-205) **Determination of a modal interaction correction for narrowband fragility data.** Kana, D.D.; Pomerening, D.J. (Southwest Research Institute, San Antonio, TX). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Laboratory tests for safety equipment operation under seismic environments in nuclear power plants have typically included various motion simulations based on either successively-applied multiple narrowband waveforms or simultaneous multifrequency broadband random waveforms. However, only broadband excitations are directly applicable when equipment performance is affected by interaction between simultaneously responding modes. Therefore, a modal interaction correction factor is developed so that a narrowed response spectrum can be transformed to an approximately equivalent broadband spectrum which accounts for modal interaction effects. The approach includes study of the fragility response of a simple two-degree-of-freedom oscillator for representative narrowband and broadband excitations, and relating the two resulting fragility response spectra. It is found that multiplication of the narrowband response spectrum by an 0.7 factor produces a conservative equivalent broadband response spectrum. The results are interpreted in terms of a secondary device responding on a primary support structure, or a primary structure having two resonances. The approach is useful for updating existing test results based on narrowband spectra, developing composite spectra for similar equipment, or providing more flexibility in designing new tests, and is applicable to qualification proof test data as well as fragility data. 10 refs., 8 figs.

45503 (NUREG/CP—0088, pp 207-233) **An experimental investigation of reduced stiffness at seismic working loads in reinforced concrete shear wall structures.** Farrar, C.R.; Bennett, J.G.; Dunwoody, W.E. (Los Alamos National Lab., NM). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Low-aspect-ratio reinforced concrete shear walls are the structural element that provides the primary lateral load resistance in Seismic Category 1 nuclear power plant structures exclusive of containment. Since 1980, Los Alamos National Laboratory has conducted a large number of experiments to investigate the seismic response of these structures and their shear wall elements. Results have shown that these structures respond to seismic excitation with a stiffness reduced by a factor of 4 from the theoretical uncracked cross-section stiffness based on strength of materials. The equivalent static load levels at which this reduction in stiffness occurs are well below the predicted first cracking load for the structures. To fur-

ther examine the response of these structures and to clarify the discrepancies between previous static and dynamic data, a large structure with six-inch (0.152 m) thick shear walls was first tested with low-level dynamic excitation and then was statically tested to failure with cyclic loading. Results showed that, prior to cracking, both the static and dynamic response are well predicted with linear analysis. For this structure, reduction in stiffness was not observed until cracking had occurred. The relation between this test and previous test results obtained at Los Alamos is discussed along with a comparison between the observed response and current US design documents. 11 refs., 12 figs.

45504 (NUREG/CP—0088, pp 235-260) **INEL/USNRC pipe damping experiments and studies.** Ware, A.G. (EG & G Idaho, Inc., Idaho Falls). Jul 1987. NTIS, PC A12/MF A01 - GPO. File Number TI87900888. (CONF-870812—).

From 9. SMIRT: international conference on structural mechanics in reactor technology; Lausanne, Switzerland (17 Aug 1987).

Since the previous paper on this subject presented at the 8th SMiRT Conference, the Idaho National Engineering Laboratory (INEL) has conducted further research on piping system damping for the United States Nuclear Regulatory Commission (USNRC). These efforts have included vibration tests on two laboratory piping systems at response frequencies up to 100 Hz, and damping data calculations from both of these two systems and from a third laboratory piping system test series. In addition, a statistical analysis was performed on piping system damping data from tests representative of seismic and hydrodynamic events of greater than minimal excitation. The results of this program will be used to assist regulators in establishing suitable damping values for use in dynamic analyses of nuclear piping systems, and in revising USNRC Regulatory Guide (RG) 1.61. 17 refs., 13 figs.

45505 (NUREG/CR—3024) **Sustained concrete attack by low-temperature, fragmented core debris.** Tarbell, W.W.; Bradley, D.R.; Blose, R.E.; Ross, J.W.; Gilbert, D.W. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Jul 1987. Contract AC04-76DP00789. 248p. (SAND—82-2476). NTIS, PC A11/MF A01 - GPO. File Number TI87014389.

Four experiments were performed to study the interactions between low-temperature core debris and concretes typical of reactor structures. The tests addressed accident situations where the core debris is at elevated temperature, but not molten. Concrete crucibles were formed in right-circular cylinders with 45 kg of steel spheres (~3-mm diameter) as the debris simulant. The debris was heated by an inductive power supply to nominal temperatures of 1473 K to 1673 K. Two tests were performed on each of two concrete types using either basalt or limestone aggregate. For each concrete, one test was performed with water atop the debris while the second had no water added. The results show that low-temperature core debris will erode either basalt or limestone-common sand concretes. Downward erosion rates of 3 to 4 cm/hr were recorded for both concrete types. The limestone concrete produced a crust layer within the debris bed that was effective in preventing the downward intrusion of water. The basalt concrete crust was formed above the debris and consisted of numerous, convoluted, thin layers. Carbon dioxide and water release from the decomposition of concrete were partially reduced by the metallic debris to yield carbon monoxide and hydrogen, respectively. The overlying water pool did not effect the reduction reactions.

45506 (NUREG/CR—4457-Rev.1) **Aging of Class 1E batteries in safety systems of nuclear power plants.** Edson, J.L.; Hardin, J.E. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jul 1987. Contract AC07-76ID01570. 39p. (EGG—2488). NTIS, PC A03/MF A01 - GPO. File Number TI87013935.

This report presents the results of a study of aging effects on safety-related batteries in nuclear power plants. The purpose is to evaluate the aging effects caused by operation within a nuclear facility and to evaluate maintenance, testing, and monitoring practices with respect to their effectiveness in detecting and mitigating the effects of aging. The study follows the US Nuclear Regulatory Commission's (NRC's) Nuclear Plant-Aging Research approach and investigates the materials used in battery construction, identifies stressors and aging mechanisms, presents operating and testing experience with aging effects, analyzes battery-failure events reported in various data bases, and evaluates recommended maintenance practices. Data bases that were analyzed included the NRC's Licensee Event Report system, the Institute for Nuclear Power Operations' Nuclear Plant Reliability Data System, the Oak Ridge National Laboratory's In-Plant Reliability Data System, and The S.M. Stoller Corporation's Nuclear Power Experience data base.

45507 (NUREG/CR—4485-Vol.2) **The impact of fuel cladding failure events on occupational radiation exposures at nuclear power plants: Case study, PWR [pressurized-water reactor] during an outage.** Moeller, M.P.; Martin, G.F.; Kenoyer, J.L. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Aug 1987. Contract AC06-76RL01830. 144p. (PNL—5606-Vol.2). NTIS, PC A07/MF A01 - GPO. File Number TI87014130.

This report is the second in a series of case studies designed to evaluate the magnitude of increase in occupational radiation exposures at commercial US nuclear power plants resulting from small incidents or abnormal events. The event evaluated is fuel cladding failure, which can result in elevated primary coolant activity and increased radiation exposure rates within a plant. For this case study, radiation measurements were made at a pressurized-water reactor (PWR) during a maintenance and refueling outage. The PWR had been operating for 22 months with fuel cladding failure characterized as 105 pin-hole leakers, the equivalent of 0.21% failed fuel. Gamma spectroscopy measurements, radiation exposure rate determinations, thermoluminescent dosimeter (TLD) assessments, and air sample analyses were made in the plant's radwaste, pipe penetration, and containment buildings. Based on the data collected, evaluations indicate that the relative contributions of activation products and fission products to the total exposure rates were constant over the duration of the outage. This constancy is due to the significant contribution from the longer-lived isotopes of cesium (a fission product) and cobalt (an activation product). For this reason, fuel cladding failure events remain as significant to occupational radiation exposure during an outage as during routine operations. As documented in the previous case study (NUREG/CR-4485 Vol. 1), fuel cladding failure events increased radiation exposure rates an estimated 540% at some locations of the plant during routine operations. Consequently, such events can result in significantly greater radiation exposure rates in many areas of the plant during the maintenance and refueling outages than would have been present under normal fuel conditions.

45508 (NUREG/CR—4834/1) **Recovery actions in PRA [probabilistic risk assessment] for the Risk Methods Integration and Evaluation Program (RMIEP): Volume 1, Development of the data-based method.** Weston, L.M.; Whitehead, D.W.; Graves, N.L. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). Jun 1987. Contract AC04-76DP00789. 296p. (SAND—87-0179). NTIS, PC A13/MF A01 - GPO. File Number TI87013918.

In a probabilistic risk assessment (PRA) for a nuclear power plant, the analyst identifies a set of potential core damage events consisting of equipment failures and human errors and their estimated probabilities of occurrence. If operator recovery from an event within some specified time is considered, then the probability of this recovery can be included in the PRA. This report provides PRA analysts with an improved methodology for including recovery actions in a PRA. A recovery action can be divided into two distinct phases: a Diagnosis Phase (realizing that there is a problem with a critical parameter and deciding upon the correct course of action) and an Action Phase (physically accomplishing the required action). In this methodology, simulator data are used to estimate recovery probabilities for the diagnosis phase. Different time-reliability curves showing the probability of failure of diagnosis as a function of time from the compelling cue for the event are presented. These curves are based on simulator exercises, and the actions are grouped based upon their operational similarities. This is an im-

provement over existing diagnosis models that rely greatly upon subjective judgment to obtain such estimates. The action phase is modeled using estimates from available sources. The methodology also includes a recommendation on where and when to apply the recovery action in the PRA process.

45509 **(NUREG/CR—4900-Vol.1) Component Fragility Research Program: Phase 1, Demonstration tests: Volume 1, Summary report.** Holman, G.S.; Chou, C.K.; Shipway, G.D.; Glozman, V. (Lawrence Livermore National Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Aug 1987. Contract W-7405-ENG-48. 207p. (UCID—21002-Vol.1). NTIS, PC A10/F A01 - GPO. File Number TI87013697.

This report describes tests performed in Phase I of the NRC Component Fragility Research Program. The purpose of these tests was to demonstrate procedures for characterizing the seismic fragility of a selected component, investigating how various parameters affect fragility, and finally using test data to develop practical fragility descriptions suitable for application in probabilistic risk assessments. A three-column motor control center housing motor controllers of various types and sizes as well as relays of different types and manufacturers was subjected to seismic input motions up to 2.5g zero period acceleration. To investigate the effect of base flexibility on the structural behavior of the MCC and on the functional behavior of the electrical devices, multiple tests were performed on each of four mounting configurations: four bolts per column with top bracking, four bolts per column with no top brace, four bolts per column with internal diagonal bracking, and two bolts per column with no top or internal bracking. Device fragility was characterized by contact chatter correlated to local in-cabinet response at the device location. Seismic capacities were developed for each device on the basis of local input motion required to cause chatter; these results were then applied to develop probabilistic fragility curves for each type of device, including estimates of the "high-confidence low probability of failure" capacity of each.

45510 **(NUREG/CR—4900-Vol.2) Component Fragility Research Program: Phase 1, Demonstration tests: Volume 2, Appendices.** Holman, G.S.; Chou, C.K.; Shipway, G.D.; Glozman, V. (Lawrence Livermore National Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Aug 1987. Contract W-7405-ENG-48. 313p. (UCID—21002-Vol.2). NTIS, PC A14/MF A01 - GPO. File Number TI87014129.

Appendices are presented which contain information concerning: details of controller and relay installation; resonance search transmissibility plots; time-history data from runs 17, 31, 46, and 56; and response spectra from runs 17, 31, 46, and 56. (JDB)

45511 **(NUREG/CR—4978) The cooldown aspects of the TMI-2 accident.** Theofanous, T.G. (California Univ., Santa Barbara (USA). Dept. of Chemical and Nuclear Engineering; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems). Aug 1987. 60p. NTIS, PC A04/MF A01 - GPO. File Number TI87900961.

The cooldown of the TMI-2 reactor vessel due to high pressure injection that occurred at 200 minutes into the accident is re-examined. Flow regimes and condensation heat transfer in the cold legs and downcomer are considered. The presence of noncondensibles (hydrogen) and a mechanism leading to its accumulation around the condensation interfaces lead to conclusions that are materially different from those of a previous study that did not consider these effects.

45512 (SAAS—344, pp 8-14) **Analysis of unusual occurrences in the field of radiography and anti-emergency measures derived therefrom.** Beise, E. 1986. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780163. (CONF-8509389—Pt.4).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

In the time span from 1970 to 1979 the probability of occurrence of unusual events in gamma radiography was three times higher than in X-ray radiography. An analysis of the unusual events in the period from January 1983 through August 1985 showed that they were caused to 83% by human and 17% by technical failure. The unusual events have been classified into 5 types and measures aimed at avoiding them are discussed.

45513 **(UCRL—96681) Installation of and experience with a new standard criticality alarm system.** Kolar, O.C.; O'Dell, A.A.; Hill, E.E.; Jackson, V.L. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 11p. (CONF-871045—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010341.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

At the Lawrence Livermore National Laboratory, we have specified a standard criticality alarm system (CAS) for use in all of the Laboratory's nuclear facilities. This paper describes the initial CAS as supplied from the vendor, as well as the modifications we have made to develop a generic system that better suits our needs. Each such system contains gamma detectors, data-acquisition modules (serviced by uninterruptible power supplies), one or more control terminals, and an emergency evacuation alarm module (also with an uninterruptible power supply). The primary function of the CAS is to sound an alarm in the event of a criticality accident, but our standard system can also be used to collect dosimetry data for assessing background radiation levels, to monitor possible secondary criticalities in the event of an accident, and to monitor post-accident conditions remotely. Steps have been taken to assure that these additional functions do not compromise the primary function. We also describe the present status of the new standard system, the experience we have had with it, and future plans for other component CASs.

45514 **Behavior of metallic uranium-fissium fuel in TREAT transient overpower tests.** Bauer, T.H.; Klickman, A.E.; Lo, R.K.; Rhodes, E.A.; Robinson, W.R.; Stanford, G.S.; Wright, A.E. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **53**: 306-307(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

TREAT tests M2, M3, and M4 were performed to obtain information on two key behavior characteristics of fuel under transient overpower accident conditions in metal-fueled fast reactors: the prefailure axial self-extrusion (elongation beyond thermal expansion) of fuel within intact cladding and the margin to cladding breach. Uranium-5 wt% fissium Experimental Breeder Reactor-II driver fuel pins were used for the tests since they were available as suitable stand-ins for the uranium-plutonium-zirconium ternary fuel, which is the reference fuel of the integral fast reactor (IFR) concept. The ternary fuel will be used in subsequent TREAT tests. Preliminary results from tests M2 and M3 were presented earlier. The present report includes significant advances in analysis as well as additional data from test M4. Test results and analysis have led to the development and validation of pin cladding failure and fuel extrusion models for metallic fuel, within reasonable uncertainties for the uranium-fissium alloy. Concepts involved are straightforward and readily extendable to ternary alloys and behavior in full-size reactors.

45515 **Characteristics of releases from TREAT source-term experiment STEP-1.** Schlenger, B.J.; Horton, E.L.; Herceg, J.E.; Jackson, W.D. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **53**: 359-360(1986). (CONF-861102—).

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

Four in-pile experiments designed to provide data regarding the physicochemical properties of material released from light water reactor fuel during severe accidents were performed in TREAT. The data supports efforts aimed at revising the source term estimating procedures used for reactor safety and siting analyses. During the first Source Term Experiments Project (STEP) test irradiated fuel elements were heated to the point of severe cladding disruption under conditions postulated for the initial core uncovery period in a pressurized water reactor undergoing a large break loss-of-coolant accident with failure of the emergency core cooling

system. A portion of the released material was collected on coupons, settling plates, and wire impactors. The morphology and elemental constituents of the collected material were determined post-test by scanning electron microscopy (SEM). This information was supplemented by additional microanalytical examinations. The released material consisted of a number of different elements. The particulate deposits were quantitatively analyzed to yield aerosol particle size distribution and concentrations.

25 ENERGY STORAGE

2506 Thermal

45516 **(BMFT-FB-T—86-173) Development of a low-temperature latent heat storage equipment. Final report.** Klages, H.; Schmitz, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Stiebel Eltron G.m.b.H. und Co. KG, Holzminden (Germany, F.R.)). Dec 1986. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770255.

The subject of this research work was the development of low-cost storage equipment for low-temperature latent-heat storage. Two storage media with different melting temperatures in view of long-time stability were tested with good results. Different laboratory-scale heat exchangers were developed. The most favourable system was installed in a 1.000 l latent heat storage facility and tested in a pilot plant.

45517 **(DOE/NBM—7014164) Thermal energy storage program description.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Energy Storage and Distribution). May 1987. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014164.

The Thermal Energy Storage (TES) Program Plan summarizes current and planned energy storage research and development, technology demonstration, and technology application. The plan detailed in this document emphasizes critical research needs building upon the success of recent efforts while exploring novel solutions to meet these needs. Research and development efforts focus on diurnal, seasonal, and industrial thermal energy storage. Specific research topics include improving thermal energy density and heat transfer rates; identifying innovative physical mechanisms suitable for heat storage; developing effective manufacturing processes appropriate for the end user; and verifying generic models enabling exploitation of site-specific large-scale storage.

45518 **(PB—87-199782/XAB) Fundamentals of thermal processes in a hybrid thermal energy storage.** Lund, P.D. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). 16 Apr 1987. 74p. (TKK-F-A—609). NTIS, PC PC E04/MF E01.

The report gives a detailed description of the time-dependent thermal processes in a hybrid heat storage. The hybrid comprises a buried water storage and is surrounded by several vertical heat-exchanger pipes in the ground. Different operational modes of the storage system is also discussed. The models developed are incorporated in a fast-run simulation program, called HYBTES, which is available both for a mainframe computer and an IBM PC.

2509 Batteries

REFER ALSO TO CITATION(S) 45305, 45817

45519 **(CONF-871027—23) Hydride generation from the Exide load-leveling cells.** Marr, J.J.; Smaga, J.A. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011361.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Stibine and arsine evolution from lead-acid cells in a 36-kWh Exide load-leveling module was measured as this module approached 1900 cycles of operation. A gas-collection apparatus enabled us to determine the maximum and average rates for evolution of both toxic hydrides. Hydride generation began once the cell voltage exceeded 2.4 V. The maximum rate for arsine occurred just above 2.5 V and consistently preceded the peak rate for stibine for each sampled cell. The average rates of hydride generation were found to be 175 μg/min for stibine and 12.6 μg/min for arsine. The former rate proved to be the critical value in determining safe ventilation requirements for cell off-gases. The minimum airflow requirement was calculated to be 340 L/min per cell. Projections for a hypothetical 1-MWh Exide battery without an abatement system indicated that the normal ventilation capacity in the Battery Energy Storage Test facility provides nearly five times the airflow needed for safe hydride removal.

45520 **(CONF-871027—28) Sodium- and sulfur-activity measurements using glass-membrane reference electrodes/sensors.** Bloom, I.; Heiberger, J.J.; Rea, K.; Redey, L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011358.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Development of miniature reference electrode systems and designs to measure either sodium or sodium polysulfide activity has continued. The reference electrodes use small (2-mm² active area), thin membranes of a highly Na^+-ion-conductive glass. Stable, reproducible emf measurements which reflect activity differences have been observed from (Mo)Na vertical bar Glass vertical bar Na_2S_4(Mo) and Na_2S/sub x/(Mo) vertical bar Glass vertical bar Na_2S/sub y/(Mo) (x = 3, 4, and 5) cells at elevated temperatures. The utility of the electrode design was demonstrated by performing coulometric titrations of polysulfide electrodes (ca. 2-mAh capacity to Na_2S_3) in the temperature range of 300 to 400°C. The coulometric titrations clearly show a sharp transition from the two-phase region to a single phase at 71 mol % sulfur. The lowest demonstrated temperature of operation for the reference electrode is 123°C in $NaCl/AlCl_3$ melts.

45521 **(EPRI-EM—5183) Lithium/iron sulfide batteries: Development and demonstration.** Barlow, G.; Chilenskas, A.A. (Gould, Inc., Rolling Meadows, IL (USA). Gould Research Center; Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. Contract W-31109-ENG-38. 107p. NTIS, PC A06/MF A01 - Research Reports Center, Box 50490, CA 94303; 1; GPO Dep. File Number DE87014222.

This volume contains two reports, each dealing with progress in the development of the lithium/iron-sulfide battery. The first report, from Gould, deals directly with the construction of cells and batteries; the second report, from Argonne National Laboratories, deals with the engineering and design of a thermal enclosure and a battery charger for the secondary battery system. Results of construction and testing of two nine-cell battery models are presented along with the beneficial effects caused by engineering changes in the ratio of positive to negative reactants. Results of design and construction of a thermal enclosure and of cycling of the lithium/iron-sulfide battery in the enclosure under an SAE driving profile are presented.

45522 **(PB—87-200820/XAB) National technical report (Matsushita Electric Industrial Company), Vol. 32, No. 5, October 1986.** (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 199p. NTIS, PC PC E07/MF E01.

Text in Japanese with English abstracts. See also PB—87-200838 through PB—87-200937, and PB—87-200796.

Contents include: recent trends of battery technology; overview of batteries, their usage and selection; ultra-thin-paper lithium battery; 1.5V-class Li/CuO battery; lithium batteries for memory backup; zinc-air batteries (button type) for hearing aids; safety design for 6AM6 alkaline dry battery; UM-4(NG) type carbon-zinc dry battery with outer metal jacket; sealed car battery CAREC Act; new-type sealed lead-acid battery F-Act; medium-capacity sealed lead-acid batteries, (MSE type); new-type high-capacity Ni-Cd battery Pananica (SM30); SC-type high-performance Ni-Cd battery Pananica; secondary lithium batteries; molten carbonate fuel cell; characteristics improvement of amorphous, silicon solar cell for indoor use; Suncarem II printed thin-film solar cell, for indoor

power sources; 100-kw photovoltaic power generation system, for factories; adapter-charger for portable VTRs; power supply unit for office automation equipment.

45523 **(PB—87-200838/XAB) Ultra-thin Paper Lithium Battery.** Kobayashi, S.; Waki, E.; Mitamura, T.; Kizawa, T.; Sato, K. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 7p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 40-46(Oct 1986).

Development of an ultra-thin battery has been in strong demand as the size and thickness of electric equipment have decreased. The Paper Lithium Battery has been developed to meet this requirement as a power source for card-type electronic equipment. The highly reliable Paper Lithium Battery has been realized by the development of superior seal materials excellent in the properties of adhesion to metal and humidity resistance, and by the adoption of a groove-type seal structure. Also, by minimizing the thickness of the component materials, the total thickness of 0.5mm, which is the thinnest in the world, has been attained. The Paper Lithium Battery has a capacity of 20mAh and a 16 X 34mm size. Although extremely thin, it still has the features of the lithium battery, such as a good storage characteristic and a flat discharge voltage. The battery is expected to be used as the power source of card-type electronic equipment, especially for thin RAM cards and multifunction IC cards.

45524 **(PB—87-200846/XAB) 1.5V-class Li/CuO battery.** Eda, N.; Fujii, T.; Koshina, H.; Morita, A.; Murakami, K. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 5p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 47-51(Oct 1986).

The 1.5V lithium battery is known for its advantage of voltage compatibility with conventional cells. In particular, the lithium battery with CuO cathode material is the most promising because it has the features of high energy density, flat discharge voltage, etc. On the other hand, it has such disadvantages as a high-voltage excursion followed by a voltage depression, and a relatively large increase in the cell thickness after discharging. These problems, however, have been solved almost completely by adding chalcopyrite to the CuO cathode. The chalcopyrite is prepared thermally from cuprous sulfide and iron disulfide. This paper discusses the synthesis of chalcopyrite and the effect of its addition, and the discharge mechanism of the cell. It also describes the structure and characteristics of the bottom cells (GR920 and 927) in which this new cathode is employed.

45525 **(PB—87-200853/XAB) Lithium batteries for memory backup.** Okuzaki, Y.; Nakai, M.; Oguro, S.; Esa, M.; Numata, K. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 10p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 52-61(Oct 1986).

Lithium batteries in general refer to those batteries which use the metal lithium for their anodes. Various types of lithium batteries have been developed. The typical types produced in quatity for consumer use are the BR and CR systems which use carbon-monofluoride and manganese dioxide, respectively, for the cathode. Lithium batteries are used as main power supplies, taking advantage of their high voltage (3 volts) and long-term reliability. Moreover, there is a noticeably growing demand for lithium batteries with terminals welded for PC board mounting, which are to be used for memory backup. In this application, the battery and the electronic components are often used under the same conditions, which include many items of reliability. Because lithium batteries satisfy these conditions, uses of and demand for them are greatly expanding. The paper describes lithium batteries and their reliability in usage by giving some examples of applications.

45526 **(PB—87-200879/XAB) UM-4(NG) type carbon-zinc dry battery with outer metal jacket.** Ashihara, R.; Kio, M.; Miyahara, K. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 6p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 74-79(Oct 1986).

In response to the recent trend toward reduction in size and thickness of battery-powered equipment, there is a rapid increase in the types of equipment which use the UM-4(R03) type dry batteries, such as headphone stereos, video remote controllers, cameras etc. This has doubled the demand for batteries of this type in the past two years. In order to meet the demand for more reliable and higher-value-added batteries applicable to a variety of small equipment, a new UM-4 (R03) type carbon-zinc battery has been developed. The battery employs an outer metal jacket which guarantees leakage resistance for the first time in the world for this size, a development which was very difficult. The metal jacket type also improves the performance of discharge and storage. To cope with the recent increase in the amount of battery-powered equipment which uses more than two dry batteries, the new NEO Hi-Top UM-4 (NG) type has greatly improved the safety, eliminating problems due to explosion.

45527 **(PB—87-200887/XAB) Sealed car battery CAREC Act.** Takahashi, K.; Hoshihara, N.; Yasuda, H.; Furuya, S.; Hasegawa, T. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 8p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 80-87(Oct 1986).

A sealed car battery must not only be safe and clean without leakage of electrolyte, gases and acid mist, but also suitable for reducting the weight and volume. Moreover, it is expected to play an important role in the design of cars in the future because of its characteristics free of the position and place for installation. The CAREC Act car battery, foreseeing the future, has been developed to meet these requirements. Although the sealing mechanism has been established, it was applicable to car batteries, because of the problems of cost and reliability in severe conditions, such as a wide temperature range and large charge/discharge current. The paper describes how these problems have been solved, especially concerning the matching with the charging system of the car, the improvement of productivity by a new separator technology, the improvement of rechargeability after overdischarging caused by the limited-solution quantity to the sealing, and the reduction in the deformation of the battery container caused by pressure reduction.

45528 **(PB—87-200895/XAB) New type sealed lead-acid battery F-Act.** Fukuda, S.; Koike, K.; Suzuki, Y.; Jinbo, H.; Sano, A. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 7p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 88-94(Oct 1986).

In the market of battery-powered portable electronic equipment, there is keen competition among manufacturers for distinction of their products in dimensional design and mechanism as well as in function. In particular, reduction in thickness is becoming a more important factor, resulting in the requirement for thinner batteries. In response to this market requirement, the F-Act new type of small sealed lead-acid battery has been developed, and has the following features: (1) A battery that is thinner than ever; (2) Make possible the production of flexible batteries mountable along a curved surface; (3) Make possible the production of batteries with larger selection of voltage and shape (by a combination of unit cells); (4) Make possible the production of batteries of the desired thickness, length and width, within certain dimensional ranges, by using a single machine (general applicability of machine).

45529 **(PB—87-200903/XAB) New type high-capacity Ni-Cd battery Pananica (SM30).** Kaiya, H.; Tsuda, S.; Yamaga, M. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 8p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 103-110(Oct 1986).

There has been an increasing demand for nickel-cadmium (NiCd) batteries of small size, light weight, and high capacity, as a result of technical improvement of portable equipment, which is the

major application of sealed type Ni-Cd batteries for cycle service. In addition, the development of a battery capable of rapid charging has been in demand. However, it was difficult to satisfy the requirements both for high capacity and rapid charging simultaneously by conventional technology. The SM30 Ni-Cd battery, which has a new positive electrode, has been developed and commercialized to meet the above requirements. A new material, foamed nickel of high porosity, has been employed for the substrate of the positive electrode. This has greatly improved the capacity density. Without increasing the weight of the battery, the battery capacity has been increased by 30%. In addition, rapid charging in 1 to 1.5 hours has been made possible.

45530 **(PB—87-200911/XAB) Secondary lithium batteries.** Toyoguchi, Y.; Yamaura, J.; Matsui, T.; Koshiba, N.; Shigematsu, T. (Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan)). 1986. 8p. NTIS, PC PC E07/MF E01.

Text in Japanese; Included in National Technical Report (Matsushita Electric Industrial Company), Vol. 32, No. 5, 116-123(Oct 1986).

It has been discovered that some fusible alloys composed of Bi, Pb, Sn and Cd exhibit good characteristics as the material of the negative electrode of secondary lithium batteries. The alloy electrode allows charging and discharging by such reaction to absorb the lithium into the negative electrode during charging, and to release the absorbed lithium into the electrolyte as ions during discharging. Because no lithium metal is deposited, no dendritic deposition occurs and the coulombic efficiency is high. Therefore, practical negative electrodes of high reliability for secondary lithium batteries can be obtained by using these fusible alloys. A secondary lithium battery has been developed by combining this negative electrode and an activated carbon positive electrode. The battery voltage is 3 volts. Long-term charge and discharge are possible. The battery is expected to be used as the memory-backup supply of microcomputerized equipment and as maintenance-free power sources for solar-battery-hybrid clocks, watches and pocket calculators, by utilizing the various features of this battery.

45531 **Interconnector device.** Christopulos, J.A. (to Secretary of the Army, Washington, DC). US Patent 4,678,728. 7 Jul 1987. Filed date 17 Sep 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an interconnector device that allows a lithium-type battery to be substituted for a Leclanche battery. The Leclanche battery is of predetermined dimensions and has a pair of coil spring connection terminals at predetermined locations on the top surface thereof. The lithium battery of different predetermined dimensions than the Lechanche battery and has a pair of female connection sockets positioned at a predetermined off-center location on the top surface. The locations of the coil spring terminals and the connection sockets of the respective batteries are at substantially different non-matching positions, comprising a thin flat water of non-conducive material of predetermined size and configuration, the wafer having the same cross-section dimensions as the Leclanche battery. A pair of prongs on the underside surface of the wafer and at locations correspond to the locations of the female connection sockets of the lithium battery. The prongs received into the female connection sockets when the interconnector device is mounted on the lithium batter. A pair of coil spring connection terminals mounted on the opposite of top surface of the wafer and having a configuration which matches that of the connection terminals of the Leclanche battery and positioned at locations which corresponds to the locations of the coil spring connection terminals of the Leclanche battery. A pair of electrical conductors plated on the underside surface of the wafer for respectively interconnecting the pairs of prongs and the pair of coil spring connection terminals in parallel.

45532 **Charge depletion meter.** Schneider, J.F. (to Secretary of the Air Force, Washington, DC). US Patent 4,678,999. 7 Jul 1987. Filed date 27 Nov 1984. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A charge depletion meter apparatus is described comprising in combination: a sensing means connecting to a battery source to sense the amount of charge flowing through, the sensing means provides a charge signal. A current to frequency converter means coupled to the sensing means receives the charge signal. The current to frequency converter means converts the charge signal to a digital signal. A divider means coupled to the current to frequency converter means to receives the digital signal. The divider means divides the digital signal by a predetermined number, the divider means provides an output pulse signal. A decimal counter means is coupled to the divider means to receive the output pulse signal. The decimal counter means accumulating the output pulse signal. Reset means couples respectively to the divider means and the decimal counter means for manually resetting both to zero. A display means is coupled to the decimal counter means to receive the output pulse signal. The display means displays the output pulse signal.

45533 **Wind energy storage test facility applications.** Neill, D.R.; Curtis, G.D.; Auker, B.H. (Univ. of Hawaii, Honolulu, HI). pp 226 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

The Hawaii Natural Energy Institute completed a wind energy battery storage project for the U.S. Department of Energy in 1985. The final report indicated that the use of battery storage would not today be economical as a load-leveler. However, the intermittent nature of wind power makes batteries practical for up- and down-ramping, and to improve power quality. Phase I of this study developed a computer model, while Phase II produced a design for a hardware system. Funds for Phase III were largely supplied by the State of Hawaii, and resulted in the wind Energy Storage Test (WEST) facility at Kahua Ranch. This paper reviews Phases I and II, and discusses progress in Phase III and the program at the WEST facility.

29 ENERGY PLANNING AND POLICY

45534 **(GB—98) Public or private electricity - the American experience. A report from the fact-finding team.** (Electric Power Engineers Association, Chertsey (UK)). Jul 1986. 110p. Electrical Power Engineers' Association, Station House, Fox Lane North, Chertsey, Surrey KT16 9HW Pound 8.95.

Against the background of the re-election in 1983 of a British government committed to transferring as much activity from the public to the private sector as possible, the Electrical Power Engineers' Association (EPEA) decided to send a fact-finding team to the United States of America to ascertain at first hand the relevance and strength of the American experience of running private monopoly electric utilities subject to public regulation. The EPEA visited a number of American electric utilities and their appropriate State regulatory agencies, as well as Congressional, Federal and national organisations in Washington, and set out to learn how the American system works from the people concerned in running it and to discuss their views of its strengths and weaknesses. Nuclear power, and conservation were also examined.

45535 **(TRADA-RR—4/86) Building details for increased thermal performance standards for timber frame housing.** Gaze, A.I. (Timber Research and Development Association, High Wycombe (UK)). 1986. 29p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The aims of the parent project, part of which is described in this report, were to determine appropriate standards for higher thermal performance for roofs, walls and floors of timber frame housing and to study the possible effects on specification following testing and approval. Appropriate U-values considered were 0.25 W/m2K for roofs, 0.3 W/m2K for walls and 0.45 W/m2K for floors. Reports on the project include a review of North American and Scandinavian details, details suitable for the UK, and describe tests on a variety of wall panels, sheathing materials and breather membranes.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 45666

45536 (UCID—19227-86) US energy flow, 1986. Borg, I.Y.; Briggs, C.K. (Lawrence Livermore National Lab., CA (USA)). 18 Aug 1987. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014318.

Although growth in the gross national product as well as total energy consumption in 1986 remained at 1985 levels, in detail there were notable changes in 1986. Industrial energy use fell to historical lows recorded in 1983 and all years prior to 1968. The drop is related to increases in end-use efficiencies and to changes in the make-up of the US industrial sector. Imports of goods and services increased as well as crude oil. The consumption of fuels for transportation increased for the third year by an amount approximately equal to the decline in industrial usage. Crude oil imports compensated for a slump in domestic oil production prompted by a downswing in worldwide oil prices. In contrast to the previous decade when the countries in the Middle East and Africa were the most important sources of imported oil and refinery products, in 1986 the three principal sources were Canada, Venezuela and Mexico. Petroleum products comprised a larger share of total oil imports from principal suppliers. Transmitted electricity increased slightly in the 1986 which was made possible by new nuclear capacity that came on line during the year. Cogeneration of electricity and process steam by industrial complexes continued to grow in part because of depressed domestic and Canadian natural gas prices and the favorable rates paid by the utilities for power that are assured by the Public Utilities Regulatory Act of 1978. Alternate sources of fuel for power production (geothermal, wind, solar, etc.) remained at 1985 levels and thus made only a small contribution to the total. The 1986 energy flow - supply and demand - is shown in graphical form using Department of Energy data.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 44994, 45116, 45173, 45174, 45175, 45176, 45209, 45212, 45331, 45534, 45551, 45567, 45584, 45586, 45589, 45592

45537 (ORNL/TM—10248) Investigation of variations in monthly market shares of light-duty vehicles. Hu, P.S.; Lee, R. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013373.

The purpose of the study was to identify systematic patterns in the monthly market shares in each of the four light-duty vehicle categories: domestic automobiles, import automobiles, domestic light trucks, and import light trucks. Time series models were developed to identify the major patterns in the monthly market shares, using the ARIMA (AutoRegressive Integrated Moving-Average) modeling technique derived by Box and Jenkins. The technique identified temporal lags in monthly market shares and estimated the coefficients of both lagged and economic variables. In general, monthly trends, gasoline prices, and low-interest financial incentive programs exhibited significant impacts on monthly market shares. Lower gasoline prices, the months of April, October and November, and low-interest financial incentives in August and September 1985 were associated with higher market shares for domestic automobiles. Termination of the financial incentives led to a decline of 6.9% (relative to the market share that was otherwise expected) in the domestic automobile market share. Lower gasoline prices, the months of March, October and November, and the financial incentive programs offered by domestic auto makers were associated with declines in the market shares of import automobiles. Perhaps surprisingly, the incentive programs also resulted in a decline of 3.4% (relative to the market share that was otherwise expected) in domestic light truck market shares.

45538 (PB—87-207072/XAB) Electric and gas rates and fuel oil prices in 18 representative US cities, 1985. Topical report, August 1985-June 1986. Schoening, N.C.; Clayton, M.D. (Alabama Univ., Huntsville (USA). Center for High Technology Management and Economic Research). Nov 1986. 272p. (UAH-RR—511). NTIS, PC A12/MF A01.

Electric and gas rates and fuel-oil prices are displayed in a manner that is understandable and comparable, thus allowing for manipulation of the data to fit individual-user needs. All rates were collected from each of the utilities located in the 18-city sample for residential, small commercial, and large commercial customers. The utility rates provided are those that have 10% or more of the specific customer class on them. The construction of this data base satisfies both the immediate need of fuel prices to compute operating costs and the longer-term requirement of the analysis of the rate structures for characteristics and trends.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 44912, 44982, 45116, 45117, 45483, 46184, 46185, 46194, 46195, 46196, 46197, 46205, 46209, 46211, 46237, 46238

45539 (CONF-8709104—2-Vugraphs) Environmental radiation standards. Kocher, D.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87012253.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

This document contains an outline of an oral presentation on environmental radiation standards presented to the American Nuclear Societies' Topical Conference on Population Exposure from the Nuclear Fuel Cycle. The paper contains several definitions, a summary of current radiation exposure limits; and numerous proposed changes to current standards. 7 figs. (TEM)

45540 (PB—87-197133/XAB) RTECS (Registry of Toxic Effects of Chemical Substances) regulatory subfile. Regulations, recommendations, and assessments (for microcomputers). Data file. Fang, J.; Sweet, D. (Robert A. Taft Labs., Cincinnati, OH (USA)). 1985. vp. NTIS CP D08.

The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC/XT or AT microcomputer using DOS 3.1. The diskettes are in the dBase III Plus format.

Regulations, Recommendations and Assessments Extracted from RTECS - Contains 4277 chemical substances which must have had one or more of the following data lines: OSHA standards, MSHA standards, DOT shipping regulations, NIOSH recommendations, ACGIH TLV, LARC assessments indicating positive or suspected carcinogenic activity in animals and/or man, and NTP positive carcinogenesis test results. Substances are listed in alphabetical order by the prime entry name. The data file can be searched by RTECS accession number, CAS Registry Number, or fragment of name or synonym. Diskettes were created in dBase III Plus format, using DOS 3.1.

45541 (PB—87-203402/XAB) Risk assessment, management, communication: a guide to selected sources. Update. Information guide. (Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.). May 1987. 108p. (EPA/IMSD—87/002-A). NTIS, PC A06/MF A01.

See also PB—87-185500.

This is the first update to the March 1987 publication entitled Risk Assessment, Management, Communication: A Guide to Selected Sources. The risk update series is divided into three major sections: Assessment, Management, and Communication. This update also includes subsections on hazardous waste, radiation, and a number of specific chemicals. Due to the expanding literature on risk, other subsections may be added to updates in the future. Each Table of Contents contains a complete list of the subsections. Updates are produced on a quarterly basis.

45542 (PB—87-205480/XAB) Health-hazard evaluation report HETA 83-194-1779, Dade County Fire Department, Miami, Florida. Salisbury, S.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 19p. (HETA—83-194-1779). NTIS, PC A02/MF A01.

An investigation was made of potential exposures to hazardous wastes (solvents) used for starting practice fires at the Dade County Fire Department aircraft fire training facility at Opa-Locka

Airport, Dade County, Florida. Used solvents donated by waste handlers or local industries had been used to start practice fires. Laboratory analysis of the soil and ground water samples taken from the burn pits revealed the presence of several common industrial solvents. The only suspected carcinogen identified was dichlorobenzene. Other potential carcinogens identified included methylene chlroide and perchloroethylene. The author recommends that the practice of using unknown solvents to help start practice fires be eliminated.

45543 **(PB—87-209045/XAB) Health assessment of exposure to developmental toxicants.** Kimmel, C.A. (Environmental Protection Agency, Washington, DC (USA). Reproductive Effects Assessment Group). Jul 1987. 14p. (EPA—600/D-87/210). NTIS, PC A02/MF A01.

In 1984, the U.S. EPA published proposed Guidelines for the Health Assessment of Suspect Developmental Toxicants. The assessment of data from studies on developmental effects of chemical exposure and the estimation of risk for humans is a difficult process. Although structure/activity relationships and data from short-term tests are often used in the risk-assessment process for assessing carcinogens, these are not useful as the first step in developmental toxicity risk assessment. Human epidemiological data are used, if available, but often the only available evidence is from animal studies. Therefore, the guidelines focus on the evaluation of data from routine animal testing studies.

2904 Natural Resources

REFER ALSO TO CITATION(S) 45237

45544 **(PB—87-199691/XAB) Recycling in Illinois: survey results and analysis.** Lindsey, G. (Illinois Association of Recycling Centers Policy, Crystal Lake (USA)). May 1987. 89p. NTIS, PC A05/MF A01.

Numerous barriers to implementing successful source separation and recycling programs exist in Illinois, many of which are market-related. There is significant concern in the private sector that existing markets for secondary materials could not absorb the large volumes of materials that would be generated if many communities separated their wastes for recycling. To address this problem the Department of Energy and Natural Resources (ENR) contracted with the Illinois Association of Recycling Centers (LARC) to develop a computerized data base of information about recycling businesses and organizations in Illinois and to prepare a report on barriers to recycling, including recommendations of possible actions, policies, and programs to minimize or eliminate them. The report is the final product of the project. It is based primarily on data collected in a survey of recycling businesses that was undertaken to compile the database.

45545 **(PB—87-202172/XAB) Implementing social feasibility in water resource planning. Completion report.** Hrezo, M.S.; Howe, W.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). Aug 1984. 73p. NTIS, PC A04/MF A01.

The study found a wide gap between the advice on public participation offered by the literature and current state public-participation programs. The current pattern of public participation in water-resource planning found in a survey of 31 states emphasizes a limited number of participants, limited types of involvement, and involvement at limited points in the planning process. Six major recommendations are offered to bridge the gap by incorporating greater consideration of social values into water-resource planning.

45546 **Optimal subsidies to new energy sources.** Solomon, B.D.; Georgianna, T.D. (USDOE Energy Information Administration, Washington, DC; Western Washington Univ., Bellingham, USA). *Energy Economics;* **9**: No. 3, 183-189(Jul 1987).

This paper broadens previous discussion on the conditions for subsidizing new energy sources. Several arguments for and against subsidizing new energy sources, such as solar energy and synthetic fuels, are reviewed and critiqued. Emphasis is given to vintage subsidies to conventional energy sources, net energy analysis, and a variety of production externalities. A theorem for determining optimal subsidies to new energy sources is developed, based on a general theorem proposed by Baumol and Bradford. Finally, two equity issues are also considered.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 44836, 44856, 44857, 44919, 44956, 45034, 45177, 45178, 45179, 45240, 45558, 45592, 45701, 45709, 46185

45547 **(CONF-8710108—1) The commercialization of technological innovations: Spatial and other correlates of success.** Brown, M.A.; Snell, S.A.; Buss, N.G. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012523.

From Applied geography conference; Knoxville, TN, USA (14 Oct 1987).

This paper examines correlates of successful technological innovation among small businesses and independent inventors. It contributes to our understanding of what is required for an inventor working outside the large corporate environment to commercialize an invention. It does this by comparing and contrasting spatial and aspatial traits of successful vs unsuccessful inventors, based on data from a recent evaluation of the Department of Energy and Department of Commerce's Energy-Related Inventions Program. Results of the study showed that commercially successful inventors shared several traits. They tended to commercialize their inventions through licensing and to share the commercialization responsibilities. They tended not to be "professional inventors," but rather have entrepreneurial expertise and interests. Spatially, the commercially successful inventions were predominantly located in the country's high technology growth regions.

45548 **(DOE/CE—0185) The tenth report to Congress: Comprehensive Program and Plan for federal energy education, extension and information activities: Annual revisions.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of State and Local Assistance Programs). May 1987. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010912.

The report draws together, in summary fashion, the many current federal energy education, extension and information efforts. The programs cover a range of energy applications and address many different and mutually exclusive audiences through an array of delivery mechanisms, including volunteer efforts, R and D initiatives and intensively managed efforts aimed at specific audiences. This report reflects the coordination efforts of federal agencies, states, local communities and private groups in carrying out these energy programs. The successes and accomplishments of the included programs are periodically evaluated to determine their continuing needs and effectiveness. Results of these evaluations are reflected by the current programs and the emphasis these programs have placed on aspects of energy conservation and use.

45549 **(DOE/ER—0144/5) Summaries of FY 1987 research in the chemical sciences.** (USDOE Office of Energy Research, Washington, DC. Chemical Sciences Div.). Sep 1987. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011210.

This publication details in research supported by the Department of Energy's Division of Chemical Sciences, which is one of six Divisions of the Office of Basic Energy Sciences in the Office of Energy Research. This publication includes projects supported by both the Chemical Sciences budget and that portion of the Nuclear Sciences budget which is administered by the Division of Chemical Sciences.

45550 **(EUR—10875-EN) Evaluation of the Community cost-shared research programme on solar, wind and biomass energy and of the Joint Research Centre's programme on non-nuclear energies (1979-1985).** Boffa, C.; Chadjivassiliadis, J.; Chemillier, P.; Stoecker, H.J.; Weaire, D.; Wehenkel, C. (Commission of the European Communities, Luxembourg). 1987. 238p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Synopsis in all EC languages.

As part of the on-going evaluation of Community research programmes, the Commission appointed in May 1985 a panel of independent experts to perform an evaluation of the Community's R and D programmes in the field of Solar, Wind and Biomass Energy, and Management of Energy in Dwellings, covering the period 1979-1985. Community action in this area includes both an R and D programme of the Joint Research Centre (JRC) as well as cost-shared R and D activities. Usually, such evaluations take place approximately mid-way through each multiannual programme in order to provide a timely input into the new programme proposals, if any. In the present case the timing has been dictated by the JRC programme schedule. The evaluation of the cost-shared activity was also included in the terms of reference of the Panel although, because of its different timing, a new programme in this field had just started.

45551 **DOE's major user facilities.** Richman, D.M. (U.S. Dept. of Energy, Washington, DC 20545). *Chemical Engineering Progress;* **83**: No. 2, 25-32(Feb 1987).

Basic Energy Sciences (BES), first in the Atomic Energy Commission, then in the Energy Research & Development Administration, and now in the Department of Energy, has funded and conducted basic research programs in the physical and related sciences and managed complex national facilities since the 1940s. Key aspects of the BES program are: responsiveness to DOE's energy mission; major support of university research and of the national laboratories in the physical and engineering sciences; and construction and operation of large and complex scientific facilities. BES' activities, carried out mainly in universities and government laboratories, underpin continuing U.S. leadership in science through scientific achievements and the training of young scientists.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 45116, 45117, 45172, 45173, 45174, 45175, 45176, 45177, 45178, 45179, 45331, 45374, 45541, 45575

45552 **(DOE/EIA—0438(87)) Commercial nuclear power, 1987: Prospects for the United States and the world.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 31 Jul 1987. 132p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87013861.

This analysis report presents the current status and outlook for commercial nuclear power reactors for all countries in the world outside centrally planned economic areas (WOCA). Information regarding operable reactors in countries with centrally planned economics is presented in an appendix. The report provides documentation of the US nuclear capacity and generation projections through 2000 that appear in the Annual Energy Outlook 1986. Projections for US nuclear capacity and generation through 2020 are presented for various nuclear power supply scenarios. These long-term projections are provided in support of the Department of Energy's activities pertaining to the Nuclear Waste Policy Act of 1982 and are used to produce the projections of fuel cycle requirements and spent fuel discharges contained in World Nuclear Fuel Cycle Requirements 1987. These projections also support the Energy Information Administration's Domestic Uranium Mining and Milling Industry: 1986 Viability Assessment and the nuclear projections contained in the National Energy Policy Plan.

45553 **(DOE/EIA—0473(86)) Nuclear power plant construction activity, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 24 Jul 1987. 61p. NTIS, PC A04/MF A01 - GPO; 1; GPO Dep. File Number DE87013213.

Cost estimates, chronological data on construction progress, and the physical characteristics of nuclear units in commercial operation and units in the construction pipeline as of December 31, 1986, are presented. This report, which is updated annually, was prepared to provide an overview of the nuclear power plant construction industry. The report contains information on the status of nuclear generating units, average construction costs and lead-times, and construction milestones for individual reactors.

45554 **(INIS-mf—10661) Importance of probabilistic evaluations in connection with risk analyses according to technical safety laws. A contribution to the clearer definition of 'risks' and 'hazards' with particular regard to the Atomic Energy Law.** Mathiak, E. (Muenchen Univ. (Germany, F.R.). Juristische Fakultaet). 18 Jul 1984. 248p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87752471.

The nuclear energy sector exemplifies the essential importance to be attached to the practical application of probabilistic evaluations (e.g. probabilistic reliability analyses) in connection with the legal risk assessment of technical systems and installations. The study is making use of a triad risk analysis and tries to reconcile the natural science and legal points of view. Without changing the definitions of 'risk' and 'hazard' in the legal sense of their meaning the publication discusses their reconcilation with the laws of natural science, their interpretation and application in view of the latter. (HSCH).

45555 **(INIS-mf—10705) Chernobyl reactor accident. A documentation submitted by the Deutsche Welle radio station.** (Deutsche Welle, Auslandsfunk der Bundesrepublik Deutschland, Koeln (Germany, F.R.)). 1986. 107p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-10676.

The documentation abstracted contains a complete survey of the broadcasts transmitted by the Russian wire service of the Deutsche Welle radio station between April 28 and May 15, 1986 on the occasion of the Chernobyl reactor accident. Access is given to extracts of the remarkable eastern and western echoes on the broadcasts of the Deutsche Welle.

45556 **(Juel-Spez—380) Third review conference of the parties of the Treaty on Non-Proliferation of Nuclear Weapons, and recent developments concerning international safeguards.** Canty, M.J.; Richter, B.; Schlupp, C.; Stein, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft). Nov 1986. 137p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-10663.

The non-proliferation activities and instruments are listed in a table. The two main instruments are the Non-Proliferation Treaty and the IAEA Safeguards, which are supplemented by treaties of regional restricted effects, such as the Treaty of Tlatelolco and the EURATOM treaty. The two-tier structure of the treaties, i.e. to provide for non-proliferation of nuclear weapons and at the same time foster the peaceful uses of nuclear energy, has proven to have a particularly stabilizing effect, which was confirmed by the last Review Conference of the Parties to the Treaty on Non-Proliferation. The conference members were particularly satisfied with the results of the IAEA Safeguards. Future developments towards improving international safeguards will concentrate on operator-friendly and financially reasonable safeguards measures, such as safeguards effectiveness evaluations and near-real-time accountancy. The results of the CAS discussions on the definition of principles and goals of co-operation for the peaceful uses of nuclear energy are of importance also to the PUNE conference. The PUNE conference will be held in 1987 and is expected to yield points of orientation for further embedding the non-proliferation principle in the

international co-operative activities and the nuclear business in the 1980s.

45557 **(PNL—6295) The economic and community impacts of closing Hanford's N Reactor and nuclear materials production facilities.** Scott, M.J.; Belzer, D.B.; Nesse, R.J.; Schultz, R.W.; Stokowski, P.A.; Clark, D.C. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87014698.

This study discusses the negative economic impact on local cities and counties and the State of Washington of a permanent closure of nuclear materials production at the Hanford Site, located in the southeastern part of the state. The loss of nuclear materials production, the largest and most important of the five Department of Energy (DOE) missions at Hanford, could occur if Hanford's N Reactor is permanently closed and not replaced. The study provides estimates of statewide and local losses in jobs, income, and purchases from the private sector caused by such an event; it forecasts impacts on state and local government finances; and it describes certain local community and social impacts in the Tri-Cities (Richland, Kennewick, and Pasco) and surrounding communities. 33 refs., 8 figs., 22 tabs.

45558 **(PNL-X—765) Assessment of the impacts of transferring certain nuclear reactor technologies to the Soviet Union and Eastern Europe.** Upton, J.W. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014388.

The Office of International Security Affairs of the US Department of Energy (DOE) has asked Pacific Northwest Laboratory (PNL) researchers to assist in evaluating the impact that transfer of specific nuclear reactor technologies may have on US national security interests. The evaluation is intended to be used as a technical basis and guideline to approve or disapprove requests from government and industry to transfer a specific technology to Soviet countries. The US Government has a responsibility to review such requests. For the post-Chernobyl information-gathering and dissemination process, the DOE is serving as the US Government's point of contact with private industry. It is DOE's policy to encourage and assist the Eastern Bloc countries to enhance the safety, reliability, and safe operation of civil nuclear reactor power plant facilities worldwide consistent with US national security and nonproliferation interests. Any requests from industry for the supply of nuclear reactor technology, equipment, and services will be considered in accordance with existing nuclear export policy, law, and regulations. All requests and proposals, whether discussed in this document or not, will be reviewed on a case-by-case basis. It should be noted that this is the initial version of the report. Subsequent, updated versions are expected to follow. Design and operation of nuclear reactor power plants involves an extensive array of technologies, not all of which have been addressed here.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 45682

45559 **(KTM/E-B—55) Incentives for combined production of heat and power in some countries.** Pellikka, J.; Koskiniemi, J. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jan 1986. 70p. (In Finnish). NTIS (US Sales Only), PC A04. File Number DE87752866.

This study examines the incentives for cogeneration (combined production of heat and power) in some countries. The most thorough study was made in USA where cogeneration at industrial facilities is provided with considerable tax credits. Moreover, in USA the sale of excess electricity is guaranteed by law (PURPA, Public Utility Regulatory Policy Act). According to the law the utilities must purchase excess electricity produced by industrial facilities at a price which the utility would have to pay as incremental cost for producing the electricity itself or for a purchase from another source. The incentives have raised disputes between different parties. It is probable that the tax credits will be abolished after 1985. In Austria and in the Netherlands considerable incentives for cogeneration are applied. In Federal Republic of Germany cogeneration based on coal is subvented in particular. Moreover, in the Netherlands and in Federal Repulic of Germany industry and utilities have made an agreement on the sale of excess electricity produced by industrial facilities. In Great Britain efforts have recently been made to improve the position of the cogeneration by legislation (1983 Energy Act). In France the sale practice of excess electricity is based on law. In Japan cogeneration is no important. The incentives for energy conservation in general may though be applied to cogeneration. In Scandinavia the incentives for cogeneration are applied only in a very small scale. In Denmark, however, cogeneration has been guaranteed a central position in the national energy planning, and the utilities and industry have agreed on the principles of the sale of excess electricity. In Sweden the competitivity of the cogeneration is not good as the price of electricity is based on cheap nuclear and hydropower. The same applies to Finland as well.

45560 **(PB—87-207429/XAB) Grid-interconnection performance requirements and current practice baseline assessment. Topical report, September 1985-April 1986.** Iverson, J.R.; Vavrina, R.D. (Onan Corp., Minneapolis, MN (USA)). May 1986. 204p. NTIS, PC A10/MF A01.

The Topical Report documents the findings of the project team during the background research phase of the contracted project effort Grid Interconnect Improvements for Cogeneration Systems. The project is intended to result in identification of alternate approaches to interconnecting small 40 kW - 800 kW gas-engine-driven generator sets for packaged cogeneration systems to electric utility systems. In the absence of uniformally accepted standards or guidelines for interconnection, utility-imposed requirements can result in interconnection costs that significantly impact the economic feasibility of small cogeneration systems. Through background research, system modeling and analysis and general engineering evaluation, an independent assessment of the necessary Performance Based Interconnection Requirements (PBIR) will be established to ascertain what necessary functions must be included in the utility-interconnect equipment to provide adequate protection for the utility and cogenerator systems. Alternate approaches for achieving the PBIR using both commercially available hardware and advanced technology will be identified. This report documents findings of the research phase which includes evaluation of applicable standards and guidelines developed by electric utilities, code-making bodies, standards-making organizations, and other research efforts; presents the PBIR and describes the current apparent accepted practices by way of baseline assessment.

2910 Conservation

REFER ALSO TO CITATION(S) 45548, 45653, 45654, 45655, 45659, 45666

45561 (DOE/S—0057, pp 93-111) **Energy efficiency: Getting the most from the energy we have.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

Today, the United States uses virtually no more energy (and less oil) than it did in 1973 - although its population is still expanding and the Nation steadily continues to turn out more in products and services. The US economy has demonstrated an impressive ability to use energy more efficiently and flexibly. Higher energy prices have stimulated the use and development of energy technologies that are more efficient. Improvements in average energy efficiency can be expected to continue, despite the decline in world oil prices - but perhaps at a slower rate. The memory of high prices in the past will continue to influence additional investments by consumers toward efficiency, and expectation of a return to higher prices at some future date will also be a factor. Some of the improvements that have already taken place involved long-term or permanent changes to capital stock (such as more efficient cars, better insulated homes, and more efficient industrial processes); and others represent behavioral changes (for example, more timely maintenance of industrial equipment). Advances in technology have accounted for two-thirds of the recent energy-productivity improvements in US industry and three-fourths of those in transporta-

tion - resulting in more product output per energy unit and more miles per gallon. Many of the most obvious and least expensive energy-conservation steps have been taken in all types of US energy uses, including residential and commercial buildings. However, the potential for energy conservation has by no means been exhausted. Further economic gains in energy efficiency should continue through the eventual turnover of almost all less-efficient capital stock (for example, autos) with new, more energy-efficient products and devices.

45562 **(EUR—10739-EN) Energy audit No. 6: Chemical industry in the European Economic Community. Summary report.** (Commission of the European Communities, Luxembourg). 1987. 122p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

The Commission of the European Communities (Directorate-General for Energy) entrusted SERETE with the task of updating a study carried out in 1982 on the energy balance of the European chemical industry, and examining thoroughly some of the conclusions of this earlier study in order to define, in particular, the means of instituting specific and effective consultations with the CFFIC, the European Chemical Federations and the profession on the activities to be pursued in terms of energy savings in the different sectors of the chemical industry. This in-depth examination proved necessary in view of the great diversity and the great complexity of the many sectors within the chemical industry (large number of product/process pairs, varying levels of technology, varying levels of information available, etc.). The present report constitutes a summary of this work on the energy balance in the Community chemical industry. This summary was drawn up on the basis of the data which figured in the previous report. These data have been updated.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 44987, 44990, 45237

45563 **(CERG-EDP—38) Motor car industry: a case study in structural change and its impact on energy demand.** Wright, A. (Cambridge Univ. (UK). Cambridge Energy Research Group). Mar 1987. 54p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is presented on the structural changes that have occurred in the major West European motor car industries and the effect these changes have had on energy demand. The development of flexible robots, the emergence of the Japanese manufacturers, the freeing of international trade, rising fuel prices and the ensuing economic depression and the need to maintain profit margins are all identified as important factors. Moreover the form of the change is determined by the prevailing economic, political and social conditions. (U.K.).

45564 (DOE/S—0057, pp A.1-A.21) **Supporting analysis for world energy outlook.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

This appendix presents detailed information about the world oil and energy market projections made for use in the Department of Energy's study of oil and security. The appendix supplies historical energy information and describes two energy future scenarios. One scenario represents a world more dependent on oil as a source of energy (the lower price case); the other scenario represents a world less dependent on oil (the higher price case). Based on the assumptions made for these two scenarios the study estimates world energy consumption by fuel types, regions and sectors and projects future world dependency on oil supplies from Persian Gulf and other OPEC sources. The scenarios were developed from various opinions on the oil market outlook and on factors such as world economic growth, world oil prices, dependency on oil and use of non-oil energy resources. A range of opinion on the market outlook for the 1990s was developed through a series of interagency discussions, involving analysts from the Department of Energy and other Federal Government agencies. The oil market outlook alone was not sufficient to support the sensitivity analyses needed to address the various policy options being considered in the review of oil and security. For the purpose of these sensitivity analyses, the Energy Information Administration (EIA) was asked to simulate typical energy market scenarios that matched, as closely as possible, the full range of oil supply and demand projections obtained from the interagency consensus. The Energy Information Administration's Oil Market Simulation (OMS) model was used to estimate a range of oil prices that was consistent with both the oil demand projections (of 49-53 million barrels per day by 1995) and EIA's latest estimates of demand responsiveness to price changes.

45565 (DOE/S—0057, pp B.1-B.8) **Supporting analysis for US energy outlook.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

The main result of this analysis was a set of projections for US energy production, imports, exports and consumption and a more detailed projection of oil supply and demand. The projections resulting from this analysis are presented in a series of tables. Using the assumptions of the lower and higher price cases, EIA made projections of future oil and gas exploration and production activities. These projections were built on the experience of the oil industry slump from 1956 to 1970, the surge in activity of the 1970s, and the recent downturn in industry activities. These projections indicate that oil industry employment and the number of feet drilled per year will increase in the 1990s compared to 1986 levels but will not attain the heights achieved in the early 1970s. EIA also examined the projected ability of US refiners to meet the levels of consumption projected under the higher and lower price scenarios. This examination showed that the existing distillation capacity of US refineries probably will be sufficient to meet the requirements of either case over the next 10 years, with utilization rates not exceeding 85 to 90%. Historically, the industry has sustained these levels and, in fact, much higher levels for long periods of time.

45566 **(EPRI-EM—5259) Electrotechnologies: Potential for improving manufacturing productivity: Final report.** Ciliano, R.E. (Mathtech, Inc., Princeton, NJ (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 303p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920558.

This report describes the technical, economic and productivity characteristics of a number of electrotechnologies and outlines their role in new integrated manufacturing systems. A classification of electrotechnologies is presented within a total manufacturing system context to include both the automation and process technologies which represent component building blocks in the overall system. Selected information available from published sources is organized according to this classification to provide an introductory background for electric utility personnel engaged in customer services, strategic planning, market research, R and D planning and load forecasting. 55 refs., 43 figs., 69 tabs.

45567 **(PB—87-206322/XAB) Illinois state buildings energy-expense study FY86 and projected FY87-90.** Jones, D. (Illinois Dept. of Energy and Natural Resources, Springfield (USA). Building Efficiency Section). Jun 1987. 35p. (IL/ENR/BE—87/02). NTIS, PC A03/MF A01.

See also PB—86-215134.

During FY86 the State of Illinois spent almost $120 million for electricity, natural gas, coal, fuel oil, propane and steam to operate state-owned and leased buildings. Over the next four years it is projected that this will increase to $134 million in FY90 due to increasing fuel costs. Although some of this cost growth could be eliminated by upgrading plants and equipment to more-energy-efficient forms, present State of Illinois budget considerations generally will not allow the large capital expenditures required. The increase in energy costs, however, can be reduced by implementing low- and no-cost operation and maintenance strategy changes. The Department of Energy and Natural Resources (ENR) State Building Energy Program (SBEP) is presently performing energy surveys of state buildings and training of facility personnel to accomplish this. In this report, the Dept. of Energy and Natural Resources (ENR) attempts to project energy costs for Illinois state buildings from

FY87 through FY90. It also identifies energy usage and cost by fuel type and agency for FY82 through FY86.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 45172, 45173, 45174, 45175, 45176, 45552, 45588, 45592

45568 **(DOE/BP/35475—T1) Municipal solid waste resource assessment for energy recovery in Idaho.** Galinato, G.; Peppersack, J. (Idaho Dept. of Water Resources, Boise (USA)). Mar 1987. Contract FG79-83BP35475. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013427.

This report discusses the energy potential from municipal solid waste (MSW) generated in Idaho. It will complement the biomass resource data base being developed by the state. These biomass resources with energy potential include forest residue, mill waste, agricultural residue, livestock waste and municipal waste. The MSW resource data is reported in a format that could be easily updated due to changes in population and availability of updated waste-stream generation rates for each county. This report will also provide preliminary information to local governments and energy project developers concerning energy potential from the municipal solid wastes generated in the state. The status of the only operating energy recovery facility in Idaho and the status of projects currently under investigation are also discussed.

45569 **(DOE/NBM—7014234) CIRRPC [Committee on Interagency Radiation Research and Policy Coordination]: Twelfth quarterly report.** Young, A.L. (Office of Science and Technology Policy, Washington, DC (USA)). 30 Jun 1987. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014234.

The policy subpanels held meetings concerning SI metric radiation units, radioepidemiological tables, and radon risk assessment. The science subpanels considered the scientific basis for radiation protection standards, and pre-disaster planning for human health effects risk assessment. Special projects include radiation protection standards fact sheets, a US population radiation exposure assessment, human and animal databases on radiation induced cancers, and ecological and agricultural effects of nuclear war.

45570 **(DOE/S—0057) Energy security: A report to the President of the United States.** (USDOE, Washington, DC). Mar 1987. 352p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE87012897.

The Department of Energy review of our energy-related national security interests, "Energy Security," was conducted at the request of President Reagan in response to his concern over declining domestic oil production and rising oil imports. It reviews and projects the nature and scope of our energy security concerns. The domestic and international dimensions of energy security are examined, and all of the Nation's principal energy resources are evaluated. Finally, this report weighs the costs and benefits of full range of policy options for meeting our energy security objectives. The Nation faces new challenges today to its energy security - and new choices. Under the President's leadership, the Nation has made great progress in building a stronger foundation of energy security in response to the energy crises of the 1970s. However, despite many gains, America is at another equally critical juncture in the state of its energy security. The crisis in the domestic petroleum industry, an industry that is critical to our energy security, is taking an enormous toll and is creating serious problems for the future. Energy security considerations carry tremendous weight and are cause for deep concern for every American. We cannot afford to be complacent. Energy security is a vital part of the foundation on which our foreign and domestic policies - and our economy - rest. As a Nation, we must recognize the warning signs and take thoughtful and prudent action that meets our responsibility to consumers, industry, and the Nation alike. I strongly commend this report to members of the Administration and Congress, and to the American people, as a focal point for serious discussion. This study provides a solid, technical data base and options for further action by the Administration and Congress to preserve energy security. John S. Herrington, Secretary of Energy. Chapters entered individually into EDB, ERA and EAPA.

45571 (DOE/S—0057, pp 1-46) **World energy outlook: Economic and security implications.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

When oil prices fell precipitously during 1986, this brought good economic news to oil consumers - and, in fact, to users of all forms of energy. Partly as a consequence of lower oil prices, however, the world as a whole will turn once again toward countries in the historically unstable Persian Gulf region - where most low-cost oil reserves and currently unused production capacity are located - to fulfill vital requirements for oil. Growing dependence on Persian Gulf suppliers has important implications for the economic, foreign policy, and national security interests of the United States. The world still gets nearly half of all its energy from oil, and this fuel accounts for well over 40% of US energy use. Thus, it is understandable that oil is the most important component in this world energy outlook. Not everyone benefited from falling oil prices. In particular, oil producers in the United States and other countries saw their revenues and profits sharply reduced. The industry responded by a drastic retrenchment, laying off thousands of skilled people and cutting back on exploration for and development of new oil reserves. Firms that build drilling rigs and numerous kinds of oil-field service companies, as well as many banks, industries, and supporting community enterprises in oil-producing areas - faced bitter financial difficulties. The debt problems of Mexico, Nigeria, Venezuela, and other oil-producing countries loomed even larger than before. The most promising question raised by the oil price collapse is what will happen if the United States and its principal allies and trading partners become much more dependent on oil supplies from the Persian Gulf region and from other countries that are members of the Organization of Petroleum Exporting Countries (OPEC), which has consistently tried to control prices by mutual agreement among major suppliers?

45572 (DOE/S—0057, pp 47-92) **US oil: Critical resource at risk.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

Although the United States is the world's second-largest petroleum producer, this country has high oil-production costs, and its currently recoverable oil reserves are relatively modest. Since oil is the country's principal energy source, the health of the domestic oil industry is critical to the Nation's energy security. For the greater part of this century, the US oil industry has been the backbone of America's energy and economic strength. Throughout a history of boom-and-bust cycles, the industry has shown a capacity to respond rapidly to rising prices when it was allowed to do so. Recently, however, the industry has undergone major consolidation as a principal result of the oil price collapse in 1986. Next time prices spiral upward, a battered oil industry may have trouble responding as quickly. Recent declines in energy prices benefit the US economy and US consumers by cutting production costs and the cost of living, while also reducing the Federal deficit. However, low oil prices simultaneously undercut the US oil industry as a whole. Low prices erode its profits and its cash-flow, and they jeopardize oil-industry loans - thus sharply reducing fresh capital expenditures, drilling, and employment. The oil-service industry is especially hard-hit. One crucial ingredient of US energy security is a more competitive domestic oil industry that will continue to explore for and develop US oil reserves. Under current low prices, exploration and production have fallen as the oil industry has retrenched. The industry needs to become more competitive, but there is no consensus yet - even within the industry - as to how this might best be achieved. This study has examined a representative sample of proposals.

45573 (DOE/S—0057, pp 113-128) **Natural gas: time for a comprehensive solution.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

The recent collapse in world oil prices has led to a significant reduction in levels of drilling activity and a decrease in US oil production. These developments have encouraged rising oil im-

ports, which at current trends could reach 50% of total US consumption. Growing import dependence places our national security at serious potential risk through possible disruptions of supplies. It is imperative that the United States take full advantage of those energy sources that can economically displace imported oil. Natural gas is a clean-burning, widely used, and domestically abundant fuel that currently accounts for about one-quarter of all US energy consumption. In many applications, natural gas can be substituted economically and easily for oil, thus reducing dependence on imports. However, natural gas cannot make its full contribution to US energy security goals unless existing impediments are removed. The time for comprehensive legislative reform on natural gas is now, so that additional reserves will be available in the 1990s when their contributions to energy security goals will be most critical. Three components contribute to the essential elements of reform legislation. Working together, these elements could ensure the fullest production of available natural gas supplies. First, decontrolling all gas prices at the wellhead would increase the proportion of old (lowest cost) gas in the market and lower average prices; second, eliminating restrictions on gas use would allow gas to compete with other fuels and allow freedom of fuel choices; and third, opening up pipeline transportation would let buyers shop for least-cost gas supplies and encourage increased competition. These three components together would provide the full benefits of a competitive market.

45574 (DOE/S—0057, pp 161-180) **Realizing coal's potential.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

By using more coal since the early 1970s, the United States and the free world have made themselves less dependent on oil without giving up economic growth. In the future, coal can do more to help this country grow economically while becoming more secure from an energy standpoint - if technical and regulatory difficulties at each stage of the "coal supply cycle" (production, shipping, and end-use) can be resolved prudently. The electricity sector has stepped up its use of coal by almost 70%, while cutting its use of oil by more than two-thirds. Even broader acceptance of coal can boost employment and improve the US balance of payments. The recent fall in oil prices that reversed the fortunes of the oil and gas industry has also chipped away at the already poor financial condition of coal producers. Profits and new investments are down, unemployment in the coal fields is high, and the survival of many marginal producers is in doubt. To achieve coal's full potential, its costs must remain reasonable, and unnecessary barriers to its use in a competitive market should be removed. The policy guidelines to reach these goals boil down to these: (1) Continued development and commercial demonstration of "clean coal" technologies. (2) An efficient coal supply chain (production, processing, and transportation) can reduce the costs of using coal. (3) Balanced environmental programs can reduce the costs of using coal, while actually improving environmental quality. (4) Reducing barriers to investment in new, upgraded, environmentally clean coal-use facilities will make coal more competitive in the marketplace. (5) A vigorous trade policy can expand US exports of coal and coal technology.

45575 (DOE/S—0057, pp 181-195) **The need for nuclear power.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

Nuclear power has helped to relieve the world's thirst for petroleum. More than 7 million barrels per day of oil would be required if oil were used to produce the electricity nuclear power supplies worldwide. France, Belgium, Taiwan, Sweden, and Switzerland get 40% or more of their electricity from nuclear power. Japan is deploying nuclear plants at the highest rate in the world. Nuclear power is needed in the United States in the context of energy security; however, its future is uncertain. There have been no new orders placed since 1978, and all projects that started construction after 1973 were canceled. Nuclear power provides about 17% of US electricity, second only to coal. No additional orders for nuclear powerplants are likely in this country until conditions have improved. Regulatory reform is needed to restore the economic viability of the nuclear option without compromising safety. Public acceptance of nuclear power is contingent on demonstrated safety and evidence of a clear path to permanently dispose of high-level waste. The Federal Government's basic policy goal is to help ensure that existing nuclear powerplants can continue to operate safely and efficiently; that those in the construction pipeline can be completed in a timely fashion to permit the additional contribution to the national energy economy they need to make; and that nuclear energy remains a choice for the long-term future that can be judged on its own merits. This chapter explains how a four-part federal initiative can help to resolve matters.

45576 (DOE/S—0057, pp D.1-D.34) **Overview and analysis of oil import fees.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

Imposing an import fee on foreign crude oil and refined petroleum products that enter the United States would raise the prices paid for all oil in this country, and this would permit domestic crude producers to operate more profitably. However, requiring everybody in this country to pay higher oil prices would raise costs for all energy and for almost everything else throughout the nation's economy; and this would reduce the rate of growths in Gross National Product. An import fee would increase US oil production (by as much as 500,000 barrels per day for a fee of $10 per barrel); it would reduce the nation's oil imports; and it would stimulate employment in oil-producing regions. However, being forced to pay higher oil prices here would also inflate costs throughout the US economy and - again, using the example of a $10 fee - this would reduce GNP between 1988 and 1995 by approximately $200 billion. By stemming worldwide oil demand, an oil fee would make oil cost less in global markets - at the same time it was raising the prices US energy buyers had to pay for it. Thus, higher oil prices in this country because of the fee would doubly handicap US businesses in both foreign and domestic markets. Lower world oil prices would also reduce the incomes of oil-exporting allies and trading partners of the United States. In short, an oil import fee would provide some clear energy security and sectoral or regional benefits, but at substantial economic cost. Between 1988 and 1995, a $10 per barrel fee would provide energy security benefits valued at $46 billion; but there would be a simultaneous reduction in GNP growth rate that would cost the nation more than four times that amount. By slowing down the economy through higher prices and inefficient allocation of resources, an oil import fee of $10 per barrel would eliminate more than three times as many jobs as it created.

45577 (DOE/S—0057, pp E.1-E.7) **Analysis of the effects of a gasoline tax.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

A tax on gasoline and diesel fuel increases the cost of highway travel and reduces motor fuel demand. In the short-term, reduced motor fuel demand would result entirely from reduced vehicle miles of travel (VMT). In the long term, vehicle fuel economy would also improve. More automobile and truck fuel economy technologies would become cost effective at higher fuel prices and consumer interest in fuel efficient vehicles would increase. Therefore, with higher gasoline prices new car fuel efficiency would increase. As more efficient new vehicles enter service the average fuel economy of all vehicles increases, but at a slower rate. If the gasoline tax is maintained over time, average fleet fuel economy keeps increasing until it becomes a more important factor in reducing motor fuel demand than reduced vehicle miles of travel (VMT). These effects are shown in a figure. Relative to a projected base case of passenger car motor fuel demand, the fuel price increase in 1973-1974 caused VMT to drop sharply. However, after 1974 the effect of improved vehicle efficiency became increasingly more important relative to reduced VMT. With the fuel price increases of 1978 to 1979, VMT again declined and this decline was subsequently mitigated by further improvements in vehicle efficiency. Gasoline taxes have other important effects beyond reducing gasoline demand. They reduce consumers' disposable income and consequently reduce consumer expenditures and economic activity. GNP is reduced and inflation increases. Unemployment increases as a result of reduced consumer expenditures.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 44856, 44857, 44912, 44919, 44956, 44962, 44982, 44982, 44987, 44988, 44989, 44991, 44992, 44993, 45564, 45565, 45571, 45572, 45573, 45574, 45576, 45577, 46184, 46185

45578 **(DOE/EIA—0035(87/04)) Monthly energy review, April 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 28 Jul 1987. 140p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. File Number DE87012958.

Current data are given on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities.

45579 **(DOE/EIA—0109(87/05)) Petroleum supply monthly, May 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 28 Jul 1987. 111p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. File Number DE87012959.

Summary statistics are presented.

45580 (DOE/S—0057, pp 211-220) **Staying prepared for emergencies.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

The Government has an important responsibility for promoting preparedness against potential energy emergencies, either foreign or domestic. The basic US policy is to ensure adequate energy supplies for the United States and to cooperate in energy emergency planning with its partners in the Organization for Economic Cooperation and Development (OECD) and the North Atlantic Treaty Organization (NATO). Past experience with energy supply disruptions has shown that government regulation of energy markets is a liability rather than an asset. Markets operate best when they are free of intrusive regulation, in emergencies as well as during normal periods. The cornerstone of US energy emergency response policy is to rely on the free market, supported by the Strategic Petroleum Reserve (SPR) in an oil supply disruption. The SPR is being expanded to a 750-million-barrel capacity, and steps are being taken to make sure that oil can be taken from the reserve and distributed effectively if these procedures ever become necessary. Globally, the United States continues to participate in the development of effective policy plans and programs of the International Energy Agency (IEA) for emergency response. It is also working with other IEA-member governments to build up strategic oil stocks further and to coordinate plans to draw on these government stocks promptly and rapidly during certain types of disruptions. The United States also joins in the planning and preparedness testing of IEA and the NATO Wartime Oil Organization. The Government's emergency planners monitor the energy situation constantly, and they improve their emergency procedures by periodically conducting realistic tests and exercises.

45581 (DOE/S—0057, pp 221-240) **International energy actions.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

One of the key lessons learned from the 1970s was that world energy markets - especially international oil markets - are extremely interdependent. Individual nations cannot "go it alone:" They are inevitably affected by the decisions and reactions of all other major market participants - in both normal and abnormal times. Much progress has been made since 1973. Energy is being applied more efficiently: Real economic growth has been possible without any significant increase in overall energy consumption, and with an actual decline in the amount of oil used. Non-OPEC production potential has developed significantly; and this increase, combined with the expanded use of coal, nuclear power, and renewable energy has helped to limit dependence on less secure Persian Gulf oil. US international energy security policy is based on and is reflective of the domestic energy and economic policy strategies that have been outlined: (1) enhancing preparedness for any likely future energy emergency - improving the ability to mitigate harmful effects from short-term supply disruptions; and (2) removing artificial barriers that make it difficult for free market forces to function, so that a mixed, balanced, and more flexible energy supply system can be developed efficiently. The United States and many of its allies are likely to become increasingly reliant on the Middle East's vast reserves of oil; and it is prudent to recall that this country shares many interests and objectives with the moderate Arab States of the Gulf. The United States can contribute much to the long-term security of energy supplies from this area by promoting those aspects of its bilateral relationships that foster regional peace and stability.

45582 (DOE/S—0057, pp C.1-C.11) **Economic analysis of oil market projections and supply disruption scenarios.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

An interagency technical group consisting of staff from the Council of Economic Advisers, Office of Management and Budget, Department of Treasury and Department of Commerce were assigned two tasks in the energy security review: to evaluate the macroeconomic effects of the alternative oil price paths developed by the Department of Energy for the period 1987 to 1995; and to analyze the effects on the oil market and the domestic economy of temporary supply disruptions. The working group was provided with two scenarios for the world economy through 1995, a lower oil price case and a higher oil price case. Each scenario included a range of different assumptions about oil prices, economic growth, geology, oil production, capacity increases, and other economic variables in order to encompass reasonable extremes for the two possible states of the world oil market and the degree of dependency by oil-importing nations. Because of multiple differences in assumptions, it is not possible to attribute the contrasts in the two scenarios to differences in one particular variable alone, e.g., oil prices.

45583 **(DOE/S—0057-H6) Realizing coal's potential: A chapter from energy security: A report to the President of the United States.** (USDOE, Washington, DC). Mar 1987. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87013096.

By using more coal since early 1970s, USA and the free world have become less dependent on oil. In the future, coal can help this country grow economically if technical and regulatory difficulties in the coal supply cycle are resolved prudently. Since 1973, coal has provided more new energy for USA than any other fuel. This nation has more coal than any other fossil fuel resource; but coal's role diminished rapidly in the first two-thirds of the 20th century. The 1970's and early 1980's brought a new coal age. Higher oil and gas prices resulted in the nation's using 0.25 billion tons more coal in 1985 than in 1974, with improved air quality. The electricity sector has stepped up its use of coal by almost 70%. Even broader acceptance of coal can boost employment and improve the US balance of payments. Future patterns of coal consumption hinge on unresolved questions, including acid rain and carbon dioxide concerns. Recent short upward spurts in demand attracted new investments and sparked new hopes, but the sustained boom predicted in the mid-1970's never materialized. Many mines that were opened in anticipation of ever higher demand are now either shut down or producing at reduced levels. There is simply no market for the additional coal. The policy guidelines are: continued development and demonstration of "clean-coal" technologies can increase world and US coal use while reducing combustion emissions; an efficient coal supply chain; balanced environmental programs; reducing barriers to investment in new, upgraded, environmentally clean coal-use facilities; a vigorous trade policy to US exports of coal and coal technology; and close consultation with industry advisory groups. (PSB)

45584 **(GBP—86/17183) Impact of offshore oil and gas related activity on the economic development of the Shetland Islands. Summary report prepared by GB Petroleum Consultants Ltd. .** (Shetlands Islands Council, Lerwick (UK)). Apr 1986. 28p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is presented on the possible impact of offshore oil and gas related activities on the economic development of the Shetland Islands. It is concluded that 1) the area to the west of Shetland is likely to prove less profitable than the area to the east and that this area is unlikely to increase local employment; 2) production from existing fields which flow into Sullom Voe terminal are likely to decline though not as much as previously anticipated; 3) employment related to offshore activity will remain broadly stable but will decrease at the oil terminals by 25-50% by the end of the century; and 4) there is little likelihood of downstream processing facilities being located in the Shetland Islands.

45585 **(NP—7770258) US hard coal mining - a study with special regard to the terms of delivery valid for industrial coal exports to the Federal Republic of Germany.** Bassier, F.R. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 5 Jul 1985. 179p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770258.

One of the typical deficiencies of most of the Western European industrial countries consists in the fact that energy supplies cannot be sufficiently covered by domestic resources but largely depend on imports instead. In 1983 imports had a share of 62.3% in the energy supply of the Federal Republic of Germany. While domestic resources were covering 86.4% of the hard coal and 94.5% of the brown coal consumption, they were covering only 3.8% of the petroleum consumption and 32.1% of the country's natural gas consumption. The poised energy import and export balance of the first post-war years was followed by an increasing dependence on imports as a result of structural changes in primary energy consumption, manifest above all in the substitution of hard coal by hydrocarbons. It was not before crude oil prices were rising during the last decade that the situation was stabilizing. Rising crude oil prices brought about a reduction in the growing energy consumption of the Federal Republic of Germany and caused the Government to provide for oil substitution programs. The study abstracted aims at discussing and critically analyzing the supply determinants for imported hard coal from the point of view of the non-metallurgical consumers with the exporting country exemplified by the USA. An analysis of that kind presupposes a closer investigation of the US coal resources and their compatibility with German quality standards and requires the assessment of petroleum deposits, the technological means and conditions of petroleum extraction, the cost of extraction in the potential export regions of the country as well as of the suppliers market structures and general domestic market structures. Based on the data and facts assessed the author points out the overall cost of the commercial transactions between the extraction site and the German consumers and presents a medium-term projection of the expected costs of US hard coal.

45586 **(NP—7770264) International petroleum trade taxes - additional financial assistance to the developing countries.** Johannsen, S. (Mainz Univ. (Germany, F.R.). Fachbereich Rechts- und Wirtschaftswissenschaften). 30 Jul 1985. 293p. (In German). NTIS (US Sales Only), PC A13. File Number DE87770264.

The publication abstracted analyzes the possible effects of the implementation of petroleum taxes on the international market. The recent increasing concern about the world's future energy supply has prompted an investigation into the effects of the realization of petroleum trade taxes. Part II describes the possible structure of the suggested taxes. Part III points out the direct effects of the levying of taxes on the countries or associated countries concerned. Due to the fact that these effects depend on the conditions determining the international petroleum market, the study focuses on the particular characteristics and features of this market. The subsequent assessment of criteria determining the distribution of tax receipts among the developing countries helps to arrive at a hierarchy of the preferment of some countries to the debit of other countries. Another section is dedicated to the analysis of indirect effects as a result of existing international interdependencies. Part IV presents a theoretical analysis of the consequences of tax loads or taxes benefited by, respectively. Empirical data serve to transfer the results obtained to real cases.

45587 **(OIES-WPM—2) Depletion policies for oil-exporting developing economies.** Stournaras, Y.A. (Oxford Institute for Energy Studies (UK)). 1984. 41p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The fact that most oil-exporting countries are developing economies has important implications for oil supply which have not been properly taken into account in the literature on exhaustible resource depletion. The way in which depletion policies are affected by trade uncertainty, given the high degree of the major oil exporters' 'dependence' on crude oil revenues, by investment time lags which delay the exploitation of (some of) these countries' comparative advantage in a petroleum based development, and by ideological objections to the ideal of a rentier society and to foreign capital are examined.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 45013

2960 Electric Power

REFER ALSO TO CITATION(S) 44964, 44990, 45552, 45558, 45560, 45594

45588 (DOE/S—0057, pp 129-160) **Electricity's future in the US.** Mar 1987. NTIS, PC A16/MF A01. File Number DE87012897.

In Energy security: A report to the President of the United States.

Electricity's share of total energy use in the United States is increasing. Demand for electricity is still rising in tandem with gross national product (GNP). It is likely that substantial new generating capacity will be needed nationwide during the 1990s to ensure an adequate, efficient, secure, and reliable supply. Under today's regulatory framework, the electric power industry may evolve in a way that is economically inefficient and unduly reliant on oil (and gas) as generation fuels. This problem has several roots: (1) The industry is experiencing a period of excess capacity, rising costs and "rate shocks" from high-cost plants coming on line. In many cases, commitments to build these plants were made before the impact on demand of the OPEC fuel-cost shocks; and their construction costs rose dramatically because of regulatory changes and delays, inflation, and problems in construction management. Regulators are now under intense pressures to allocate some of the enormous costs of these plants between ratepayers and investors. (2) Today's regulatory environment prompts electric utilities to focus on short-term economics ... and to avoid new capital investment. (3) Most options with lower capital costs are attractive, but their potential appears limited. (4) Many utilities are looking primarily to gas-fired combustion turbines to satisfy remaining supply needs. (5) Generation of electricity by nonutility sources is up dramatically. (6) Generation is also increasing in sectors of the industry that receive low-cost Federal financing. Fundamental regulatory changes may be required to ensure reliable and economical electricity supplies in the 1990s and beyond.

45589 **(EPRI-P—4463-SR-Vol.4) TAG Technical Assessment Guide: Volume 4, Fundamentals and methods, end use: Special report.** Gellings, C.W.; Hanser, P.; Haas, S.M. (Electric Power Research Inst., Palo Alto, CA (USA). Energy Management and Utilization Div.; Decision Focus, Inc., Palo Alto, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 204p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920582.

This Technical Assessment Guide (TAG), prepared by EPRI personnel, has been compiled for the use of EPRI staff and its contractors to provide a common basis for evaluating electric energy R and D alternatives. This volume gives a detailed explana-

tion of economic analysis procedure for electricity end-use technologies. It examines seven different perspectives for the evaluation of demand-side activities, using net present value as the basis for evaluation. 42 refs., 22 figs., 28 tabs.

45590 **(EPRI-P—5350) Selected papers on priority service methods.** Oren, S.S.; Smith, S.A.; Wilson, R.B. (Pricing Strategy Associates, Orinda, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 265p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920552.

The research described in this EPRI report has addressed four key considerations regarding priority service: understanding customers' needs and their diversity, identifying product attributes that can be economically unbundled to meet those needs, understanding the ability of the electricity system to deliver diverse products, and designing mechanisms for practical implementation. In the 5 technical papers, the results obtained to date regarding each of these research issues are described in detail.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 44990, 44991, 45561, 45578

45591 **(CERG-EDP—39) Structural change and energy use in the metals industries in Western Europe.** Bending, R.; Wright, A. (Cambridge Univ. (UK). Cambridge Energy Research Group). Mar 1987. 44p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

A report is presented on the structural changes that have occurred in the major West European metals industries and the effect these changes have had on their energy demand. The changes in energy intensity are evaluated for the steel industry and in the nonferrous sector, for aluminium, copper, lead and zinc. (U.K.).

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 44856, 45205, 45212, 45221, 45226, 45237, 45240, 45243, 45245, 45273, 45274, 45550, 45568, 45570

45592 **Emerging renewable energy R and D: The federal perspective.** San Martin, R.L.; Costello, R. (DOE, Washington, DC). pp 99-103 of Energy solutions today for the nineties. Chu, S.L. New York, NY; American Society of Civil Engineers (1987). (CONF-870435—).

From Energy '87: energy solutions today for the nineties; Atlantic City, NJ, USA (27 Apr 1987).

Collectively, renewable energy technologies offer a significant opportunity to increase diversity and flexibility within energy markets. By these means, renewable energy technologies provide the option of directly matching various energy requirements with local renewable resource availability. Modularity of renewable energy systems allows additions to be made in comparatively small increments, resulting in short lead times, reduced planning uncertainties, and comparatively small capital outlays over short time periods. Renewable energy technology development also offers the potential for a number of long-term economic benefits. First, successful development will serve to limit the need for imported energy commodities. Second, continuation of the U.S. leadership role in renewable energy development presents export opportunities for American industry. Third, a number of renewable energy technologies are compatible with the ongoing transition of U.S. industry toward a high technology base. Finally, these technologies should generate diverse employment opportunities for a variety of skilled, semiskilled, and unskilled labor. Based on current Department of Energy projections, renewable energy can be expected to contribute increasingly to the Nation's energy supply. Increasing requirements for electric power, manageable but continuing real increases in the cost of conventional energy (e.g., oil, gas, coal), and a sustained period of economic growth all improve the projected competitive position of renewable energy technologies over the longer term.

30 DIRECT ENERGY CONVERSION

3004 Thermionic Converters

45593 **(AD-A—181658/6/XAB) Low-work-function emitter electrodes for advanced thermionic converters.** Davis, P.R.; Schwind, G.A. (Oregon Graduate Center, Beaverton (USA). Dept. of Applied Physics and Electrical Engineering). 1986. 10p. NTIS, PC A02/MF A01.

Pub. in Applied Surface Science, Vol. 25, 355-363(1986).

The utility of low-work-function emitter materials for advanced thermionic energy converters is discussed. Recent experimental results obtained for the (310) face of LaB_6, a prototype advanced emitter surface, are presented and discussed. The availability of this and other thermally stable, low-work-function materials offers considerable promise for the future of advanced thermionic energy conversion.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 45522

45594 **(AD-A—181545/5/XAB) Pre-prototype 5-kW fuel-cell power-plant development. Final report, 20 May 1982-30 January 1986.** Abens, S.; Farooque, M. (Energy Research Corp., Danbury, CT (USA)). Apr 1987. 41p. NTIS, PC A03/MF A01.

A five-kilowatt Phosphoric Acid Fuel Cell (PAFC) power plant, with the ability to operate on neat methanol, was developed and tested. Overall thermal efficiency at full load (based on the lower heating value of methanol) was 32%.

45595 **(DOE/MC/23136—2342) The effects of halides on the performance of coal gas-fueled molten carbonate fuel cell: Semi-annual report, October 1986-March 1987.** Magee, T.P.; Kunz, H.R.; Krasij, M.; Cote, H.A. (International Fuel Cells Corp., South Windsor, CT (USA)). May 1987. Contract AC21-86MC23136. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006483.

A program was established to determine the effects of chloride and fluoride present in gasified coal on the performance of molten carbonate fuel cells. A literature survey and thermodynamic analyses indicate that conversion of the molten carbonate electrolyte to halide will result in electrolyte loss and performance decay. Material corrosion will also be accelerated. In order to quantify these effects as a function of halide content, a test plan was written consisting of the measurement of anode and cathode performance in a half-cell as a function of halide content, corrosion tests, and fuel cell tests with halides introduced in the reactants. The results of these experiments will be incorporated in a model to allow the prediction of performance decay due to halides. This report describes the results obtained in the first six months of this investigation.

45596 **(EPRI-AP—5319) Demonstration of a high-efficiency steam reformer for fuel cell power plant applications.** Udengaard, N.R.; Christiansen, L.J.; Summers, W.A. (Haldor Topsoe, Inc., Houston, TX (USA); Westinghouse Electric Corp., Large, PA (USA). Advanced Energy Systems Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 104p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920574.

Full-scale tests of a new modular steam reformer confirm its suitability for a wide range of fuel cell power plant applications. This new fuel processor offers interested utilities excellent performance, operating flexibility, reliability, and maintainability.

45597 **(EPRI-AP—5349) Fuel processor development for multimegawatt fuel cell power plants.** Olesen, O.L. (International Fuel Cells Corp., South Windsor, CT (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 99p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920580.

The definition of a 16 to 25-MW fuel processor is a key accomplishment in the effort to commercialize phosphoric acid fuel cells by the mid-1990s. Designed to operate at lower temperatures and higher throughput capacities, this fuel processor improves reliability and lowers plant costs.

45598 **(N—87-23718) Electrochemical performance and transport properties of a Nafion membrane in a hydrogen-bromine cell environment.** Baldwin, R.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1987. 27p. (NASA-TM—89862; E—3529; NAS—1.15:89862). NTIS, PC A03/MF A01.

The overall energy conversion efficiency of a hydrogen-bromine energy storage system is highly dependent upon the characteristics and performance of the ion-exchange membrane utilized as a half-cell separator. The electrochemical performance and transport properties of a duPont Nafion membrane in an aqueous HBr-Br_2 environment were investigated. Membrane conductivity data are presented as a function of HBr concentration and temperature for the determination of ohmic voltage losses across the membrane in an operational cell. Diffusion-controlled bromine permeation rates and permeabilities are presented as functions of solution composition and temperature. Relationships between the degree of membrane hydration and the membrane transport characteristics are discussed. The solution chemistry of an operational hydrogen-bromine cell undergoing charge from 45% HBr to 5% HBr is discussed, and, based upon the experimentally observed bromine permeation behavior, predicted cell coulombic losses due to bromine diffusion through the membrane are presented as a function of the cell state-of-charge.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 45227, 45561

3201 Buildings

REFER ALSO TO CITATION(S) 44955, 45535, 45704

45599 **(BMFT-FB-T—86-165) Improvement of the efficiency and drastic reduction of manufacturing costs of IC engine driven small fuel oil and gas heat pumps. Final report.** Brockhoff, G.; Husse, U.; Kurz, W.; Lueck, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Fichtel und Sachs A.G., Schweinfurt (Germany, F.R.)). Dec 1986. 108p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770252.

The developed fuel oil- and gas-heat pumps (with a heating capacity of 20 kW) have still shown a too big number of malfunctions and weaknesses because the components available on the trade market often have been unsuitable for using in IC engine driven heat pumps. All parts of the heat pump have been touched up thoroughly. There have been developed stable components; some components could be dropped or have been combined and integrated. The objectives of the research program have been reached. The cost reduction program led to savings in all sectors of the engine-compressor-unit. Regarding the heat pumps, the targets of the planned cost reduction have been reached, except some parts of the refrigeration circuit where long-term tests are necessary to ensure a service life of 40,000 operation hours of the heat pumps. With 3 refs., 50 figs.

45600 **(BSRIA-TN—2/87) Numerical air flow modelling.** Whittle, G.E. (Building Services Research and Information Association, Bracknell (UK)). Mar 1987. 12p. BSRIA, Old Bracknell Lane West, Bracknell, Berkshire, RG12 4AH Price Pound 15.00.

Numerical techniques are under development which can solve the equations of fluid dynamics to predict fluid flow and heat transfer in a wide range of engineering applications. The methods, from the field of computational fluid dynamics, are based on solving the fundamental equations of conservation of momentum, energy and mass. They are now being applied to study air movement and convective heat transfer in buildings. This technical note reviews these numerical methods and demonstrates by application what can be achieved. The emphasis is placed on a physical interpretation and understanding of the processes involved rather than detailed mathematical descriptions.

45601 **(BSRIA-TN—11/86) Selection of air-to-air heat recovery systems. Technical note.** Hamilton, G. (Building Services Research and Information Association, Bracknell (UK)). Sep 1986. 24p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Recovery of the heat that would otherwise be rejected as exhaust streams from ventilation or process air, and using this energy to assist the heating of incoming fresh air, may be considered as one of various energy conservation options. Four different methods of air to air heat recovery are described: Run around coils, Plate heat exchangers, Rotary regenerators (Thermal wheels) and Heat pipes. Relative advantages and disadvantages of each system are given, together with guidance on taking the principal design decisions needed for each system. Tabular information is presented on typical occupancy periods, fresh air quantities required, energy needed to heat incoming air, fuel costs, energy recovery efficiencies and supplementary energy requirements, so that fuel cost savings may be estimated.

45602 **(CONF-8511303—) Report on the 1985 annual meeting of the German Association of Refrigeration and Air-Conditioning Engineering (DKV).** (Deutscher Kaelte- und Klimatechnischer Verein e.V., Stuttgart (Germany, F.R.)). 1985. 804p. (In German). NTIS (US Sales Only), PC A99. File Number DE87770270.

From Eurogress Aachen '85: annual meeting of Deutscher Kaelte- und Klimatechnischer Verein e.V.; Aachen, F.R. Germany (20 Nov 1985).

The conference report by Deutscher Kaelte- und Klimatechnischer Verein e.V. (DKV) (German Association of Refrigeration and Air-Conditioning Engineering) contains the papers presented at the 1985 annual meeting at Aachen from 20 to 22 November. The papers cover domestic refuse incineration calculation of working fluid parameters for refrigeration engineering, preconditions for system calculation etc. The papers were presented both in plenary and working group sessions the latter of which come under the following categories: Cold supply in high-performance superconducting magnets; Progress in components and its transfer to practical applications; Applications for the engineering practice; New experience and developments; Heat pump technology; Shelf-life of deep-frozen food; The advent of the chip in the air-conditioning and refrigeration industry. (HAG).

45603 **(ECRC/M—2090) Industrial heat pumps.** Bertinat, M.P.; Benstead, R.; Heaton, A.V.; Hodgett, D.L.; Green, R.H. (Electricity Council Research Centre, Capenhurst (UK)). Oct 1986. 122p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK .

This report covers the area of industrial heat pumps. After a brief introduction as to where to use a heat pump, the topics examined include, heat pump fluids, sizing and control, process integration and heat pumps, steam compression and HVR, heat pump assisted distillation and drying by heat pumps. Heat exchangers and compressors for heat pumps are areas covered in the appendices.

45604 **(ECRC/M—2127) Trace heating of domestic hot water pipework.** Stephen, F.R.; Mason, C. (Electricity Council Research Centre, Capenhurst (UK)). Apr 1987. 22p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK .

Monitoring of hot water systems in dwellings has shown that even where well insulated cylinders are installed, the system efficiency is only around 50% due to energy losses in the pipework. Insulating the distribution pipework improves the system efficiency to around 70%. The application of electric trace heating to insulated pipework enables hot water to be available immediately from the tap, improves the system efficiency to around 75% and effectively doubles the volume of useful hot water available compared with a non-insulated pipework system.

45605 **(ECRC/M—2130) Analysis of the consumption of electrically heated hot water in houses.** Stephen, F.R. (Electricity Council Research Centre, Capenhurst (UK)). Apr 1987. 34p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK .

A survey of 43 houses with electrically heated hot water was undertaken. Data from the survey were analysed and the following conclusions reached: householders were not aware of the importance of good cylinder insulation, family size directly affects the volumes drawn and the accesses made to the hot water system daily. Hot water cylinders should be sized to cater for maximum daily demand. Electric showers reduce the hot water demand on a central store. The average efficiency of the hot water systems monitored was 50%. Insulation is essential for all hot water pipings and thermostats were found to be only approximate guides to hot water temperatures.

45606 **(ECRC/M—2154) Consumption profiles for gas and oil heated hot water in houses and a comparison of usage patterns with electrically heated water.** Stephen, F.R.; Mason, C. (Electricity Council Research Centre, Capenhurst (UK)). Jun 1987. 56p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK .

A survey of the consumption of electrically heated hot water was undertaken by the Electricity Council Research Centre, and consumption profiles derived from the data collected. The survey was extended to include a small number of houses with gas and oil systems heating the domestic hot water, thus enabling consumption profiles to be obtained and compared with electrically heated systems. The results show that gas and oil heated systems exhibited hot water consumption profiles with three major demand periods a day similar to those determined for electrically heated systems. For all three types of water heating systems the day of maximum demand was found to be Sunday. Electrically heated systems consumed the largest average volumes of hot water, gas the smallest.

45607 **(ECRC/M—2184) Steam heat pump for increasing the energy efficiency in distillation.** Hodgett, D.L.; Chalmers, E.; Mitchell, A.A. (Electricity Council Research Centre, Capenhurst (UK)). Jul 1987. 12p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK .

The first heat pump for distillation on the UK was installed in a malt whisky distillery in 1986. Novel aspects of the system are the modifications to the process to enable continuous and efficient operation of the heat pump across a number of batch stills, the use of steam as the working fluid in a closed cycle and compression of the steam by a twin-screw compressor. The installation demonstrates the large savings in prime energy which can be achieved by the optimised integration of heat pumps within unit operations.

45608 (EPRI-EM—5168, pp 1.1-1.14) **Myths and the mystique of heat pumps: what the heat pump can provide the customer and you.** Matson, W.F. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The myths of heat pump marketing are discussed. These myths are: utility customers are generally informed of heat pumps and what they can do; efficiency is not important to customers; competitive fuel prices are too low to make heat pump sales attractive; electricity is the high-priced fuel; heat pump technology has matured and will be outstripped by advances in gas heating and cooling technology; electric-driven heat pumps can't compete with high-efficiency gas furnaces; heat pumps are unreliable; heat pumps only heat and cool; their company can't afford to give a discount; electric heat usage is small and at a standstill and heat pump sales are static; unitary residential air conditioner sales will continue to increase; heat pumps are applicable in new construction only; and having dual-fuel capabilities is prized and the public knows of add-on heat pumps. Some ideas for marketing heat pumps are presented and discussed.

45609 (EPRI-EM—5168, pp 2.1-2.5) **Builder's success story with heat pumps.** Schmitt, B. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

One builder's experience with heat pumps for heating and cooling residential building is described. The builder has been building homes using heat pumps in the Cleveland, Ohio area for about 15 years. A comparative evaluation is given for heating and cooling homes using electric heat pumps and natural gas.

45610 (EPRI-EM—5168, pp 3.1-3.6) **Builders and the heat pump; a national overview.** Mintz, M.M. (National Association of Home Builders). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The following topics are discussed: review of National Association of Homebuilders (NAHB) activities in the area of interest; a characterization of builders and their needs, and what needs are and aren't being met by the electric utility industry; what motivates builders in selecting equipment to heat and cool their homes; a survey called Decisions for the 1990s, about what people prefer and what they will prefer over the next 10 years. This gives builders an insight into what they should be offering in the way of product; and a survey done through the research foundation called Housing Industry Dynamics, which attempts to characterize equipment choices in different parts of the home.

45611 (EPRI-EM—5168, pp 4.1-4.5) **Builder's perspective of heat pump marketing.** Winstead, H. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

A home builder's experience in building residential buildings using heat pumps is related. The advantages and disadvantages of heat pumps versus natural gas furnaces are discussed. It has been found that heat pumps have lower operating costs and one can get the addition benefit of air conditioning with the same equipment.

45612 (EPRI-EM—5168, pp 5.1-5.39) **Heat pump technology overview.** Crawford, J. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The following topics are discussed: a manufacturer's perspective on heat pumps and their technology; and trends are identified which will help utility representatives focus on those segments of the industry and technology which are of major consequence in serving their customers.

45613 (EPRI-EM—5168, pp 6.1-6.7) **Meeting customer needs with heat pumps.** Greiner, P.C. (American Electric Power Service Co.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The heat pump heats, cools, and it provides hot water. No other device can produce such year-round comfort. But it was not always looked to with great favor. Back in the 1950s, the early days of residential heat pumps, they did not sell very well. Reliability and equipment life weren't nearly what they are today - but, a select group of customers still wanted them because they provided comfort and convenience, flamelessly. Much has happened to the heat pump since those early days. Design and manufacturing have improved its reliability, flexibility, and longevity so that today the heat pump enjoys a much improved reputation and greater acceptance than ever before. Nationally, it is estimated that approximately three million heat pumps are in service today. National heat pump shipments from 1972 to 1985 are shown. In the early 1970s they were being installed at the rate of about 100,000 per year. But last

year alone, the number of heat pump shipments grew by more than 10% to 800,000 units. The largest breakthrough in heat pump technology will occur when the nonreciprocating compressors (rotary, compliant scroll, etc.) are combined with a low-cost, solid state inverter which will allow one compressor to have many capacities controlled by the shaft rotation speed. This technology, under development in the US and Japan, however, appears to be three to five years away.

45614 (EPRI-EM—5168, pp 7.1-7.21) **Residential heat pump applications.** Fairchild, P.D. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Customers and competitors determine success in the marketplace. In the residential sector, competition is becoming keener and customers are demanding more choices. In addition, many electric utilities are attempting to influence the customer's choice of specific electric end-use equipment in order to manage load shape and make more efficient use of their generation and distribution facilities. What motivates the residential customer? How will the energy service needs of these customers change in the years ahead and how can utilities prepare for these changes? How can heat pumps help utilities deal with these challenges and uncertainties? These questions are addressed. Present and future heat pump equipment options for residential applications options for responding to specific customer and utility needs and for staying competitive against fossil fuels in the important residential end-use market are discussed.

45615 (EPRI-EM—5168, pp 8.1-8.8) **Tennessee Valley Authority's heat pump program and the Tennessee Valley Heat Pump Training Association.** Needham, V.A. III; Jenning, F. (Tennessee Valley Authority). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The Tennessee Valley Authority's (TVA) heat pump program including TVA's heat pump training program are discussed. The overall objective of the training program is to improve the skills of everyone engaged in the design, installation, and servicing of heat pumps. This training program is conducted by the Tennessee Valley Heat Pump Training Association (TVHPTA). The organization promotes the exchange of information plus a better personal acquaintance among its members.

45616 (EPRI-EM—5168, pp 9.1-9.6) **Residential heat pump marketing.** Simmons, H.O. (Lincoln Electric System, NE). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The Lincoln Electric System (LES) is one of the many utilities across the nation that has reinstituted marketing of residential heat pumps. LES re-entered the marketplace nearly four years ago, after almost a decade of keeping silent about the benefits of heat pumps, electric appliances, or even electricity. To help understand the heat pump marketing program, key events that led LES to re-enter the marketing/promotional business are discussed. Some of the details of the program, how it was modified based on experience, and the results that have been measured are discussed.

45617 (EPRI-EM—5168, pp 10.1-10.5) **Promote Our Product (POP) Program for employees of Alabama Power Company.** Denney, F.D.R. (Alabama Power Co.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

In May 1985, Alabama Power Company initiated a marketing incentive plan for its employees. The plan takes its name from its purpose: Promote Our Product (POP). Designed to increase sales of heat pumps in the residential market, POP has four specific objectives: (1) to encourage all employees to promote heat pumps in order to meet competition; (2) to increase demand during the off-peak winter season; (3) to increase revenues from the use of electricity for residential heating; and (4) to help customers get the best energy value for their money. To determine the incentives that would prompt employees to participate in POP, previous campaigns that had been successful were reviewed. As a result of the review, POP was based on cash incentives for prospects and for actual sales. Such incentives not only generate prospects from employees, but also maintain their interest until the sale is made and the heat pump is installed.

45618 (EPRI-EM—5168, pp 11.1-11.5) **Gulf States Utilities' experience with heat pump marketing.** Smith, J.A. (Gulf State Utilities Co., Beaumont, TX). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Gulf States serves approximately 485,000 residential customers. Their service area extends 350 miles westward from Baton Rouge, Louisiana, to a point about 50 miles east of Austin, Texas. Gulf states had an active marketing program from the end of World War II until the early 1970s. Beginning in the early 1980s they began to explore various ways to re-establish their marketing efforts. One of the first areas examined was the residential market saturation. Their 1980 survey showed that 76.6% of their customers used gas for space heating, while 21.6% used electricity. Heat pumps were used for space heating by 4.7% of their customers. In 1984, a heat pump marketing program was implemented to capture a greater market share of the heating business, with a goal of 900 heat pump sales. The actual sales for 1984 were 1371 units, or 152% of their goal. A number of sales aids were used during 1984, including newspaper, radio, and television advertisements. A tune-up campaign was designed to get prospects for dealers. An incentive program was developed for dealers who sell and install heat pumps. This program is discussed.

45619 (EPRI-EM—5168, pp 12.1-12.22) **Marketing residential heat pumps.** Gellings, C.W. (Electric Power Research Institute, Palo Alto, CA). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

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Approximately 45 utilities in the US have heat pump marketing programs. These programs include customer education and advertising programs, direct contact programs, financial incentives, trade ally programs, and alternative rates. Some utilities are beginning to bundle two or more marketing techniques together in order to add greater value to customers. For example, having a heat pump marketing program that not only positions the heat pump in a meaningful way to customers but also provides economic benefits will be important. Programs involving trade allies are also becoming more important because of the critical input they provide in evaluating heating/cooling system options. At first glance, it appears that there is a wide range of success in heat pump marketing programs. Even after the obvious differences between service territories have been removed, such as competition, relative prices, and how well established heat pumps are, it still appears that there is little consistency between the relative effects of rebates, alternative rates, and promotion. The understanding of customer preference and behavior and the ability to mold a heat pump preference in a customer's mind are discussed. As the customer's view of electricity purchase/use/consumption is examined, the puzzle of which marketing programs work best in each location beings to fall in place.

45620 (EPRI-EM—5168, pp 13.1-13.6) **Electric utility and heat pump marketing.** Stephens, R.L. (S & S Air Conditioning, Dallas, TX). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Manufacturers, distributors, dealer/contractors, and electric utilities all have a vital interest in how to improve the market penetration of electric heat pumps. How the industry and the electric utilities can work together to accomplish this goal is discussed. For

a short time heat pumps were the fastest growing segment of the heating, ventilating and air conditioning (HVAC) markets; however this is not true today. The heat pump industry (manufacturers, distributors, dealer/contracts) and the electric utilities all profit from the increased sale of heat pumps, but from the industry viewpoint it appears that electric utilities may have more to gain than industry. To some electric utilities, heat pumps offer a way to provide more cost-effective service to all their customers. The HVAC industry also serves the consumer, and it tries to do so in a way that will generate repeat and new business so sales and profits will continue to grow. Electric utilities and industry have demonstrated in the past how they can team up to satisfy consumers and penetrate a market. Some techniques for marketing heat pumps for increased sales are presented.

45621 (EPRI-EM—5168, pp 14.1-14.4) **Delmarva Heat Pump Association: a case study.** Van Dornick, R.J. (Delmarva Power & Light Co., Wilmington, DE). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The idea of forming an association to advance the interests of an industry is not new, but the idea of forming an association specifically to promote the heat pump was new back in 1979, when the first heat pump association was charted in Salisbury, Maryland. Associations are formed because more can be achieved collectively than can be done individually. The Delmarva Heat Pump Association (DHPA) is an outstanding example of how people (competitors) working together are making a difference not only for themselves but for their customers and industry as well. The formation of DHPA, America's first heat pump association, is discussed.

45622 (EPRI-EM—5168, pp 15.1-15.2) **Meeting Rural Electric Cooperative (REC) customer needs with heat pumps.** Wobler, G.C. (Chippewa Valley Electric Cooperative, Cornell, WI). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

A vast restructuring is changing the shape of utilities, creating new opportunities for the resourceful, leaving those less resourceful by the wayside. The winners are the creative specialists who developed techniques new to the business, and the innovative cooperatives that have repositioned themselves with new consumer-driven marketing strategies. In the last 10 years rural electric cooperatives (RECs) have severely cut back on marketing. This trend must be reversed and RECs must become more involved in the consumers' choice of equipment in order to intelligently manage load growth and better utilize existing facilities. The challenge is to capture a share of the heating and cooling load that is beneficial to both the consumers and utility. Methods for achieving this goal are discussed.

45623 (EPRI-EM—5168, pp 16.1-16.7) **Alternative plus: a quality heat pump program.** Watson, J. (Ohio Edison Co.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Ohio Edison Company is located in northern Ohio and serves approximately 800,000 customers. In the decades of the 1960s and 1970s, customers installed over 18,000 heat pump systems in their residential and commercial buildings. During the natural gas moratorium in the late 1970s, the total of all types of residential space heating systems resulted in a 50% market share of 12,000 to 15,000 new residential living units each year. During the first half of the 1980s, the American Gas Association (AGA) and the local natural gas companies became convinced the heat pump was a major threat to their space heating business and began an aggressive anti-heat pump program. They have been quite successful in changing customer perceptions of the value of heat pump applications. This has resulted in a lower market share (30% to 40%) of much lower construction levels of 4000 units per year. Also, the competitive attack has caused concern over their ability to retain their existing heat pump customers. Alternative Plus is Ohio Edison's answer to the AGA challenge. The Alternative Plus program which was formally began in January 1985, is described.

45624 (EPRI-EM—5168, pp 17.1-17.16) **Market opportunities and products for the commercial and institutional sectors.** Tambornino, C.J. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

When they say heat pump, as applied to residential markets, everyone pretty well knows what is meant, but the term heat pump in the commercial, industrial, and institutional markets, can mean lots of things. What is meant by heat pumps and various heat pump systems is discussed. The commercial market, in total, is not a fast growing market. But, the various heat pump systems being offered to commercial customers today are a fast growing segment of the total market and will become a bigger piece of the market in the future. Why commercial customers like heat pump systems, what the benefits are to the user and how these systems work together are discussed. Most importantly, it is shown why heat pumps in commercial buildings are a great system for the electric utilities to promote.

45625 (EPRI-EM—5168, pp 18.1-18.7) **Comfort, costs, and decision-making in commercial building design.** Fleming, W.S. (W.S. Fleming and Associates, Inc.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The information in this study is presented from two viewpoints, i.e., that of a person in a small-to-medium-sized business who must make final decisions relative to the HVAC system going into commercial buildings that he owns, and that of one who provides technical services to the electric and gas utility industries and mechanical engineering design services to Fortune 500 commercial building owners. Decision-making is relatively easy when a business is small. A business with 10 employees or less makes office space decisions based on the lease cost, availability to clients, and employee satisfaction. The key ingredients to be evaluated in a commercial building lease/buy decision are: (1) economic stability of the firm, and (2) desire for income with tax sheltering advantages. These ingredients are discussed and evaluated.

45626 (EPRI-EM—5168, pp 19.1-19.2) **How to conduct a field day.** Heisler, J. (Heistek Corp., Sioux Falls, SD). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

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Marketing applications of light commercial earth-coupled heat pump equipment (of a type similar to that sold in the residential sector) are discussed. A field day program, a type of program that would appeal to a residential marketplace, was not together. The presentation was called a field day because one is actually out in the field watching the installation of an earth-coupled, water-source heat pump. The field day approach for the residential marketing that is being done in the Dakotas is described. If it works for residential, why would it not work for commercial? The commercial field day is very similar, with a couple of changes For a commercial field day, for instance one might want to change how the participants are selected. Instead of a group of homeowners, one might want to pick a group of building owners with a need. Some commercial building owners do not realize that they have a need. A field day may tell them that they do. The elements for putting together a successful field day program for commercial building owners are presented.

45627 (EPRI-EM—5168, pp 20.1-20.2) **Manufacturer's perspective on commercial heat pump marketing.** Gilles, T.C. (Lennox Industries Inc.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

There are a large number of good heating systems offered as electric heat pumps for commercial applications. There are package terminal heat pumps, high-efficiency heat pumps, closed-loop systems, conventional water source systems, conventional ground-coupled heat pumps, as well as the gigantic unitary market. There are half a dozen or more proven concepts in large applied systems that are available to meet the existing and new commercial construction market. The vast size of the existing commercial market presents a tremendous marketing opportunity, because there are over 3 million commercial buildings today of 10,000 square feet or less. There are 800,000 buildings out there today of 10,000 to 50,000 square feet. Of those buildings, over 50% are heated with gas, and less than a third use electricity for heating. So there is a real opportunity to go out and sell. Methods for marketing heat pumps in the commercial sector are discussed.

45628 (EPRI-EM—5168, pp 21.1-21.6) **Meeting commercial customer needs with water-source heat pumps.** Cooper, B. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

A design/build project is one where all the elements of the trades gather in one room and have it out. Lines are not drawn between functions such as architectural, engineering, general contractor, mechanical contractor, and supplier. Approvals, involving submittals and resubmittals back up through the chain of command are not needed either. This is a process in which the owner, the general contractor, the mechanical contractors, and even certain suppliers will meet and discuss the building design. The building will be designed and developed, and the entire decision-making process will be a joint venture. Anyone involved who has any input during that process cannot at a later date come back after the final approval is given and say, I forgot the piping. If they do, they have to put it in at their own expense, because they had the opportunity to express themselves during the design/build conference. This method of meeting a commercial customers' needs using waste-source heat pumps is described.

45629 (EPRI-EM—5168, pp 22.1-22.24) **Large-scale heat pumps for energy conservation in institutional buildings.** Niess, R.C. (Dames & Moore, Bethesda, MD). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Many divergent events - ranging from the 1973 energy price disruptions, the second energy crisis in 1979, and the recent reduction in Federal spending to today's changing tax legislation - have made energy conservation projects both necessary and fruitful for many institutional entities. At first, the simpler conservation measures were taken. The implementation of more sophisticated technologies followed, gradually increasing the capital expenditure requirements per unit of energy use reduction. A major focus area is the recapture of energy in resources that are now being wasted to the environment. From a capital expense viewpoint, heat exchange is preferred. However, heat exchange requires a waste temperature higher than the target capture temperature, which may not be practical or even technically feasible. Where these conditions occur, the use of heat pumps, or a combination of heat pumping and heat exchange, is a viable alternative. Over the past years, many such installations have been made, each supported by economic justification. The major end use is space heating, followed by domestic water heating and, to a lesser degree, the production of hot water for process purposes. The use of heat pumps for energy conservation in institutional buildings is discussed.

45630 (EPRI-EM—5168, pp 23.1-23.16) **Commercial and industrial marketing of heat pumps.** Prindle, B. (Edison Electric Institute, New York, NY). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Methods for the commercial and industrial marketing of heat pumps are presented. The study briefly characterizes the market - the commercial customer; summarizes what Edison Electric Institute (EEI) members are doing in commercial marketing, from the perspective in Washington; and addresses some of the EEI programs that are on-going or in the planning stage, which will support and enhance the things that are going on around the country.

45631 (EPRI-EM—5168, pp 24.1-24.19) **Working with developers, architects, and engineers.** Scanlon, P.W. (Burt Hill Kosar Rittelmann Associates). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Methods for working with developers, architects and engineers to promote the use of new heat pump technologies to meet the energy demands of new buildings are discussed. The marketing of innovations in a very complex industry which, because of its nature, is basically resistant to change is described. Information is presented on: lessons learned from previous research and experiences in introducing innovations into the general building industry (much of this information comes from research beginning in the early 1970s aimed at promoting the use of solar energy as an alternate energy source); and how these lessons can be applied to the specific area of interest (i.e., marketing new technologies in the commercial building sector of the industry). A brief overview of the construction industry and the process by which other innovations gradually penetrate the marketplace are described.

45632 (EPRI-EM—5168, pp 25.1-25.2) **Commercial and industrial electric heat pump option.** Thomas, M.E. (Alabama Power Co.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The Commercial and Industrial Electric Heat Pump Option Program was developed by a task force of electric utility and manufacturer representatives assisted by a consulting firm - Enviro-Management and Research. The task force was organized as a result of a survey of the utility industry taken in the fall of 1983 which indicated the need for product application information and promotional materials for heat pumps in the commercial and industrial markets. When the task force began its work in the spring of 1984, it became apparent that a single publication could not easily meet the identified needs and the decision was made to develop separate publications. The finished product, which became available in early 1985, consists of a Marketing Guide, a Technical Manual, an Audio Visual Presentation, and two Consumer's Information Bulletins. Each is available separately to allow users maximum flexibility in utilizing some or all of the program to best fit their needs. These publications are described.

45633 (EPRI-EM—5168, pp 26.1-26.6) **Marketing heat pumps: a class product.** Mull, T.D. (Carolina Power & Light Co.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The marketing of heat pumps to improve the learning environment in school buildings is described. Recognizing that remodeling older school buildings was imperative, Carolina Power and Light Co. embarked on an innovative program to improve the quality of the educational environment, conserve energy, save the taxpayers money, and market heat pumps. The results of the program are presented.

45634 (EPRI-EM—5168, pp 27.1-27.4) **Bottom line for commercial heat pump sales.** Coleman, W.R. (American Electric Power Service Corp.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Methods for increasing sales of heat pumps in the commercial sector are discussed. With all the types of heat pump equipment and control options available today, there is an almost unlimited possibility of reducing initial cost, maintenance cost, and operating labor. The key decision to specify heat pumps in the commercial market is usually made for business reasons rather than customer emotion.

45635 (EPRI-EM—5168, pp 28.1-28.21) **Residential space heating with heat pumps: a utility perspective on the technology options.** Young, D.J. (Ontario Hydro). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

An electrically driven heat pump represents the wisest possible use of electric energy for space heating. With system efficiencies of 200% to 300% or more, some types provide the lowest operating cost of any available heating system, with the possible exception of burning free wood. These are the benefits that accrue to the customer, but that's only part of the story. For the electric utility, some heat pump systems offer improved winter load factors (compared to conventional electric heating) and reduced winter or summer peak loadings. In some cases, these loadings can be less than half those that must be met when conventional technologies are used. These two families of benefits, one set for the customer, and one set for the utility, add up to a net societal benefit that cannot be matched by any other heating/cooling technology. The advantages of using heat pumps for residential space heating are discussed.

45636 (EPRI-EM—5168, pp 29.1-29.7) **Closed-loop water-source heat pump systems.** Hughes, H.M. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

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A closed-loop heat pump system is a balanced heat recovery system. This means that all internal heat is used before adding heat. The water loop is the transport system; moving heat from where it is not wanted to where it is wanted or to where it can be rejected, e.g., from the core to the perimeter of a commercial office building. Heat pumps are the means for raising the temperature of the heat to a usable level, or of providing cooling and rejecting the heat efficiently and conveniently. Water-loop heat pump systems have been in use for about 30 years, but have only become widespread in commercial applications in the last 10 to 15 years. Water-source heat pumps have established an enviable record of reliability - the ASHRAE Handbook chapter on life cycle costing cities an average life of 19 years. The heat pump itself, a very simple piece of equipment, is described.

45637 (EPRI-EM—5168, pp 30.1-30.15) **Domestic water heating from heat pumps, air conditioners, and refrigeration machinery.** Hiller, C. (Electric Power Research Institute, Palo Alto, CA). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Domestic hot water can be provided from vapor compression cycle machinery in essentially two ways, i.e., desuperheaters - water heated by removing sensible heat from hot refrigerant, lowering its temperature to approximately the saturated vapor state, but performing relatively little condensing of the refrigerant (condensation occurs in a separate heat exchanger, typically air cooled); and full condensing - water heated by completely condensing the refrigerant to a liquid state, with no other heat exchanger necessary.

45638 (EPRI-EM—5168, pp 31.1-31.7) **Water-source heat pumps: the better alternative for electric heating systems in the US.** Bierbaum, A.C. (Iowa Association of Electric Cooperatives, Urbandale). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Water-source heat pumps have an operating cost advantage over air source heat pumps in all parts of the US, with the advantage increasing in the north. A water-source unit with a compressor desuperheater coil for domestic hot water can provide another 1000 to 2000 kWh savings per year in heating domestic hot water (the savings are greater farther south due to the greater air conditioning run time). Even though the savings in the Deep South are not as pronounced, homes along ocean coast lines can also incur savings by using an indoor water-Freon condenser coil rather than an outdoor air-Freon condenser coil that is prone to deteriorate because of salty air conditions (water-source heat pumps were originally developed in the Gulf-Coast areas to eliminate this problem). The advantages of water-source heat pumps are discussed.

45639 (EPRI-EM—5168, pp 32.1-32.13) **Water-source heat pump performance.** Hannifan, J.M.; King, J.E.; Thomann, G.C. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The Kansas Ground-Source Heat Pump Manual is intended to assist utility marketing personnel, builders, HVAC contractors, architects, and engineers in understanding ground-coupled heat pump technology, and to provide sufficient information on system performance and cost to analyze the economic value of individual systems based on building and utility specific conditions. The manual reviews heat pump operating characteristics, with particular attention to the difference between air-source and ground-source systems. The manual also describes domestic water heating options which complement water-source heat pumps. It presents a procedure for estimating the installed cost of air- and water-source heat pumps, along with tables of current costs. Kansas statutes and administrative rules and regulations which directly affect water-source heat pump systems are reviewed. Finally, lists of current heat pump manufacturers, distributors, and installers/dealers are given, along with additional sources of information and references.

45640 (EPRI-EM—5168, pp 33.1-33.7) **Emerging cool storage technologies.** Wendland, R.D. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

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Cool storage - a technique for shifting all or a part of the air conditioning load from peak to off-peak hours - offers the potential to reduce peak electricity demands, build off-peak load, and generate significant savings in customers' electric bills. Although storage systems have a higher first cost than conventional air conditioning, there have been several hundred installations in the past few years. This has occurred for three reasons: high demand charges and/or favorable time-of-use (TOU) rates, direct financial incentives by the utilities, and utility demonstration projects. Increasing numbers of storage systems have been installed each year for the past five years in areas where favorable rates are in place and/or where incentives exist. The objective of the several storage system vendors, innovative design engineers, and utilities, with support from EPRI research, is to accelerate the acceptance of cool storage. This will occur only if an increased return on investment can be achieved by a combination of reducing first costs, increasing efficiency, and improving reliability. The air conditioning mechanical system using storage consists of several subsystems: refrigeration equipment, storage tank, chilled water and air distribution, and controls. The achievement of an improved storage system will require the optimization of the separate subsystems and the proper integration of these subsystems into cost-competitive mechanical packages. Activities underway and planned by EPRI and others to address these issues are discussed.

45641 (EPRI-EM—5168, pp 34.1-34.16) **Evaluating heat pump supplemental heat alternatives for residential and commercial applications.** Gilles, T.C. (Lennox Industries Inc.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The widespread continuing dominance of electric heat in new residential and commercial construction is causing an increase in winter power demand at a rate faster than that of the summer demand due to I^2R supplemental heat with heat pumps and other direct element systems. This widespread use of electric heating is generally due to lower equipment first cost compared to gas equipment, the continuing increase in the number of new residential units being built with central air conditioning, and the lack of natural gas service in most new construction areas. In 1983, 71.7% of all new multifamily and 48.3% of single-family residential construction was equipped with electric heating. Unitary air source heat pumps were used in over 30% of the new homes. Methods for initiating a successful marketing program for commercial and residential heat pumps are presented.

45642 (EPRI-EM—5168, pp 35.1-35.6) **New and future heat pump technologies.** Creswick, F.A. (Oak Ridge National Lab., TN). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—). Contract AC05-84OR21400.

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It is not possible to be sure what future heat pumps will look like, but there are some interesting possibilities. In the next five years, they are likely to see US heat pumps with two kinds of innovations: capacity modulation and charge control. Capacity modulation will be accomplished by variable-speed compressor motors. The objective of charge control is to keep the refrigerant charge in the system where it belongs for best performance; there are probably many ways to accomplish this. Charge control will improve efficiency and durability; capacity modulation will further improve efficiency and comfort. The Stirling cycle heat pump has several interesting advantages, but it is farther out in time. At present, they don't know how to make it as efficient as the conventional vapor-compression heat pump. Electric utility people should be aware that major advances are being made in gas-fired heat pumps which could provide strong competition in the future. However, even a gas-fired heat pump has a substantial auxiliary electric power requirement. The resources needed to develop advanced heat pumps are substantial and foreign competition will be intense. It will be important for utilities, manufacturers, and the Federal Government to work in close cooperation.

45643 (EPRI-EM—5168, pp 36.1-36.3) **Current heat pump development.** Lannus, A. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

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In the last decade, some of the greatest changes in the way energy is used in buildings have occurred in heating and cooling, where the competition among alternative energy sources has become especially intense. In the face of increasing demand for air conditioning in residential and commercial buildings, capturing the heating load by electric utilities would result in better utilization of generating capacity, increased revenues per kilowatt of peak demand, and, in the longer run, lower costs to customers. Although conventional (i.e., resistance) electric heating may see new applications where spot or task heating is required, the principal electric technology for capturing the vast potential of the heating market is the heat pump. The heat pump is the most efficient electric heating technology commercially available. Indeed, a record 821,000 unitary heat pumps were shipped by the US air conditioning industry in 1985. Although 30% of all new single-family and 60% of new multifamily dwelling are equipped with heat pumps, the large majority of heat pump sales have been in the Sunbelt states. An advanced heat pump is described which is under development by Carrier Corporation. The heat pump is designed to improve the comfort delivery as well as energy-economics of heat pump technology.

45644 (EPRI-EM—5168, pp 37.1-37.16) **Refrigerant mixtures for heat pumps.** Didion, D. (National Bureau of Standards). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

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The refrigeration systems of today are generally rather complex, highly varied with application, and are all a result of a long development process which was comprised of equal amounts of science and practical experience. Of these many applications the residential heat pump has among the most demanding performance criteria because of the reversing process (i.e., heating and cooling functions) and the fact that the dependence of the capacity and load on ambient temperature is not matched (i.e., as the load increases the machine's capacity decreases). Furthermore, within the field of heat pump applications, there are many varied installations causing the numbers of a given manufacturer's product line to be too few to permit perfectly matched components. As a result, compressors, heat exchangers, etc., are designed to be compatible with as many different heat pump models as possible. Or, to put it more accurately, models are usually comprised of components that are available rather than those that might have been tailored to meet a specific application. This usually results in a more cost effective unit which has some built-in sacrifice in performance. The development of new refrigerant mixtures for heat pumps is discussed.

45645 (EPRI-EM—5168, pp 38.1-38.16) **Advanced compressors for improved heat pump load matching.** Riegger, O.K. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

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Use of air-source heat pumps as primary heating systems in northern climates is hindered by a well-known phenomenon; their heating capacity is reduced as the ambient temperature decreases. A typical heat load curve for an average home is shown. The reduced capacity of the air-source heat pump at lower temperatures is exactly opposite of what is required, since the heating load increases as the ambient temperature decreases. A number of schemes have been proposed to improve the load matching capabilities of the air-source heat pump. Two such schemes are discussed. The first method involves increasing the capacity of the compressor, while the second obtains selective improvement in compressor capacity by varying compressor speed.

45646 (EPRI-EM—5168, pp 39.1-39.18) **Rating electric heat pump performance.** Didion, D. (National Bureau of Standards). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Laboratory testing and rating of heat pumps by bin analysis or any other method is not field simulation. It is, at best, an attempt to establish a relative scale of merit of the aggregated field performance parameters of one unit versus another. In other words if one unit performs better than another unit in the field and the test/rating results agree the major objective is accomplished. In addition, it is hoped the average field frosting and cycling degradations are approximately that of the lab test/rating results. There are too many variables introduces by the installation to attempt to obtain a field performance prediction from a rating value on anything but a statistical basis. Such factors as duct losses, thermostat adjustments, building insulation, internal loads, and local weather are capable of significantly influencing a heat pump's annual performance. Since these factors are site specific and a given model will necessarily be installed in a wide variety of sites, it is not possible for a single rating to be indicative of the annual energy consumption of a given unit in a given year. On the other hand, if one wants to know which unit is a better energy performer or even what dollar savings might be achievable over the unit's lifetime (for the purpose of rate of return on investment or life cycle cost calculations) these rating procedures are the best basis currently available. These rating procedures are discussed.

45647 (EPRI-EM—5168, pp 40.1-40.26) **Evaluating and sizing equipment: tools and guidelines.** Howell, R.H. (Univ. of Missouri, Rolla). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Heat pumps are available in various types and sizes and, in order to have satisfactory operation, it is necessary to properly size the unit. An undersized unit will not maintain comfort conditions and could require additional costs of operation whereas an oversized unit will have a higher than necessary initial cost, may have maintenance problems due to short cycling, and could have difficulties in providing dehumidification during the cooling season. Various guidelines can be recommended for sizing different types of heat pumps for both commercial and residential applications. Various techniques and guidelines are available for evaluating the performance of heat pumps on both an energy and a cost basis. It would not be unusual for one type or size of heat pump to deliver the best performance based on energy consumption, while it could be the least desirable on an economic basis. Sizing and evaluating guidelines are discussed along with some of the tools available for these tasks.

45648 (EPRI-EM—5168, pp 41.1-41.3) **Installation, operation, and maintenance training via national teleconferencing.** Bose, J.E.; Weaver, R. (Oklahoma State Univ., Stillwater). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

On September 4, 1985, Oklahoma State University offered a free national teleconference on closed-loop/ground-coupled heat pumps. Two hundred fifty-eight known downsites received the telecast, with estimates of the number of viewers ranging from 12,000 up. The program was jointly sponsored by private industry and Oklahoma State University. It became apparent that continually offering installation and design workshops at the Stillwater, OK, campus was taking more time than could be allocated by the available personnel. Persons traveling to a workshop missed approximately one week's work and any person traveling from out of state probably had travel and lodging expenses of at least $1000. On the other hand, for a teleconference, the telecast cost per participant was only about $4 to $5 (for an estimated audience of 12,000). Teleconferencing as a training tool in the installation operation, and maintenance of heat pumps is discussed.

45649 (EPRI-EM—5168, pp 42.1-42.15) **Alabama experience with heat pumps.** Lovvorn, N.C. (Alabama Power Co.). 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

Much attention has been given to heat pump life, maintenance cost, reliability, and efficiency by both the utility and HVAC industry personnel. Two approaches to analyzing these issues have been used: one using hard data and one using opinions. This discussion focuses on hard data gathered from heat pumps installed in Alabama and covered by Alabama Power Company's Assured Heat Pump Service Program. The Electric Power Research Institute (EPRI) sought out Alabama Power in 1984 to perform certain tasks relating to heat pump reliability. One outgrowth of that effort was a survey of known heat pump owners to determine the useful life of heat pumps. The Alabama Power program had units installed under its Certified Dealer Program as early as 1964 and a companion 10 year Assured Service Program was put into effect in 1967. Results of the survey are presented and discussed.

45650 (EPRI-EM—5168, pp 43.1-43.3) **In situ performance testing of heat pumps for maintenance recommendations.** Thieken, J. 8 Apr 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920481. (CONF-860477—).

From Meeting customer needs with heat pumps: a seminar and exposition; Kansas City, MO, USA (8 Apr 1986).

The Salt River Project (SRP) is the nation's oldest and most successful multipurpose reclamation project. For decades it has been Arizona's largest deliverer of water; in recent years SRP has grown to become one of the five largest public power utilities in the country. In 1980, SRP started an Energy Efficient Home Program, designed to increase the energy efficiency in new single-family residential home construction. The Program includes a standard requiring the installation of high efficiency air conditioning and heat pumps. SRP, through its energy audit program, has for many years advised consumers of the benefits of thermal envelope retrofits. In March 1984, attention was turned to retrofit air conditioners and heat pumps. The intention was to offer cash incentives to customers who would replace their old equipment with new high efficiency systems. Results of the program are presented.

45651 **(GB—89) Investing in energy efficiency. 3. New housing.** Baldwin, R.; Atkinson, G. (Building Research Establishment, Watford (UK)). Dec 1986. 4p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Building Research Establishment Information Paper. No. 3.

The third of a short series of Information Papers concerned with the economic assessment of energy efficiency-measures in new housing is presented. The effects of installing additional thermal insulation in the ground floor, the exterior walls and the loft, installing double glazing or maximising passive solar heating are assessed in a standard, semi-detached house.

45652 **(KTM/E-D—123) Lifetime and need for renovation of HVAC-control equipment. The determination of economic-technical lifetime and need for renovation of existing control equipment of HVAC-processes.** Sulku, J.; Harjanne, P.; Itkonen, H.; Schreck, T.; Antikainen, J. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 104p. (In Finnish). NTIS (US Sales Only), PC A06. File Number DE87752868.

Reviews and measurements done suggest that 10-30% of control systems perform energy efficiently unsatisfactory. Energy efficiency of control equipment is not emphasized in questions of their maintenance. Mostly desicious are based on poor climatic performance or maintenance problems of a going equipment. A guide of renovation is proposed emphasizing energy efficiency. To ease the decision, a measurement method to show the performance of HVAC-control equipment, is presented. Detailed description of performance of 25 units is included. It turned out that normal maintenance staff is not clearly aware of the energy efficiency of control equipment, through lack of knowledge and measurement possibilities. Purchased services to improve efficiency are considered costly compared to expected adwantages. Methods to improve the energy efficiency of control equipment included that designers and equipment suppliers should realize energy efficiency of control equipments as a major part of the quality of their services and that standard solutions and measurements could remarkably lower the edge of realising the performance of control equipment, also to the maintenance staff.

45653 **(LBL—8678-Rev.2) DOE-2: sample run book, Version 2.1C.** (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 612p. NTIS, PC A99/MF A01 - National Energy Software Center, Argonne National Lab., 9700 Cass Ave., Argonne, IL 60439; GPO Dep. File Number DE85012582.

Supersedes LBL—8678-Rev.1.

Sample outputs here are a condensed version of identical runs on computer tapes available from the National Energy Software Center. It acts as an instructional vehicle to demonstrate the relations of inputs and displays in the programming code. (PSB)

45654 **(LBL—8688-Rev.4) DOE-2: BDL summary, Version 2.1C.** (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 92p. NTIS, PC A05/MF A01 - National Energy Software Center, Argonne National Lab., 9700 Cass Ave., Argonne, Il 60439; GPO Dep. File Number DE85012580.

Supersedes DE8312486.

This package of updates to the DOE-2 documentation brings the previously published materials up to Version 2.1C of the DOE-2 program. The user may verify that the program being used is 2.1C by checking the first page of the output and also the upper right hand heading of any output page of the computer printout.

45655 **(LBL—8706-Rev.4-Suppl.) DOE-2: supplement, Version 2.1C.** (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 300p. NTIS, PC A13/MF A01 - National Energy Software Center, Argonne National Lab., 9700 Cass Ave., Argonne, Il 60439; GPO Dep. File Number DE85012581.

Supersedes DE83011814.

This publication contains detailed discussions and instructions for using the new features and enhancements introduced into the 2.1B and 2.1C versions of the program. It assumes a thorough understanding of the basic manual, and is not intended for stand-alone use by new users of the program.

45656 **(LBL—22271) Building design: Impact on the lighting control system for a daylighting strategy.** Verderber, R.; Jewell, J.E.; Morse, O. (Lawrence Berkeley Lab., CA (USA); Pacific Gas and Electric Co., San Francisco, CA (USA)). Sep 1986. Contract AC03-76SF00098. 15p. (CONF-871065—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009159.

From IEEE/IAS annual meeting; Atlanta, GA, USA (19 Oct 1987).

This paper discusses the unique features of a multistory office building that successfully permit most of the space to be daylighted and the electric lights to be dimmed by a cost-effective centralized system. This system includes: the use of light shelves, sloped ceilings, and proper building orientation and symmetry, and supplies only the ambient illumination. Measurements of the daylight illumination levels and the performance of the lighting control system indicate that daylighting can provide over 70% of the required ambient illumination through the year. Based on the installed cost of the lighting control system, its payback period is 2.2 years.

45657 **(NEI-FI—9) Indirect lighting in office buildings.** Hejazi-Hashemi, M.G.; Hiltunen, E.; Kallasjoki, T. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 59p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE87752867.

Indirect lighting is superior to direct lighting in many situations. Even if the lighting level is lower than in well planned direct lighting of the same effect, indirect lighting has certain advantages concerning veiling reflections and glare. Recently, small metal halide lamps have begun to be used in indirect lighting systems. They are more efficient than fluorescent lamps in direct lighting systems. That means that there is sufficient illumination with lower energy consumption. The aesthetic result is also usually better because of smooth shadows. It is impossible to make a general comparison between the total costs of indirect and direct lighting because the costs vary considerably in each case. Besides, at this moment, the lumen depreciation and lamp mortality curves of different light sources (for example metal halide lamps) are unknown. It is also difficult to compare two different lighting installations. only certain specific properties of lighting can be measured. The weight of each property is different depending on the situation. In addition, it must be remembered that the aesthetic aspects are at least as important as the technical aspects. The first modern large-scale indirect lighting system in Finland was installed in the new office building of PI-Consulting Ltd. The system was based on the use of metal halide lamps. The electrical effect of the lighting system met the standard recommendations for direct lighting with fluorescent lamps. Lighting measurements and questionaire results demonstrated the advantages of this form of indirect lighting. Total costs were the same as in direct lighting systems with fluorescent lamps. The initial investment was lower in the indirect system although the maintenance costs were higher.

45658 **(NP—7770271) Small indoor swimming-pool at Schwalmtal. Space HVAC systems in changing and shower rooms. 4. Interim report.** (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany, F.R.)). Dec 1985. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770271.

A ventilation device was installed in the small-sized indoor swimming-pool at Schwalmtal to recover energy from off-air. The publication reports on the heat requirement and heat gain characteristics of changing and shower rooms as well as on the experience gathered with the first ventilation device installed. Key figures are established regarding the dimensioning of ventilation systems, and hints are given regarding the utilization of the energy potential available from the shower-room off-air. Particular attention is given to the establishment of the rate of water evaporation in the shower rooms as well as to the effect of the variable rate of users on the usefulness of energy contained in the off-air.

45659 **(PB—87-184750/XAB) NBSLCC program (for microcomputers). Software.** Petersen, S.R.; Ruegg, R.T. (National Bureau of Standards, Washington, DC (USA). Center for Applied Mathematics). Apr 1987. vp. NTIS CP D99.

The software is contained on 5 1/4-inch diskette, double sided, double density compatible with the IBM PC XT AT microcomputer. Diskettes are in the ASCII format. Price includes documentation, PB—87-180253. Contact NTIS Computer Products for prices.

The diskette provides the NBSLCC programs and related files referenced in NBS SP 709, Comprehensive Guide for Least-Cost Energy Decisions. The NBSLCC programs perform economic analysis of buildings, building systems and components, with special emphasis on energy-conservation projects. Software Description: The software is written in Basic for implementation on IBM-PC/XT/AT machines using the MS-DOS operating system. A minimum of 128K bytes of core storage is required.

45660 **(PB—87-214110/XAB) Interim procedure to measure the thermal performance of window systems.** McCabe, M.E.; Goss, W.P. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jun 1987. 124p. (NBSIR—87/3569). NTIS, PC A06/MF A01.

The purpose of the report is to review the current sources of information on U-values and to describe the state of thermal test methods used for windows in order to provide the Bonneville Power Administration with some general guidelines in the application of thermal test data for use in the Model Conservation Standards (MCS) by the Northwest Power Planning Council. At present, considerable controversy exists in the window industry regarding the thermal testing of windows, therefore no consensus-based standards are available.

45661 **(SBI-R—183) SBI low energy house model 86. Design details and energy consumption.** Blach, K.; Kjaer, B. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1986. 16p. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm.

EFP-80.

This report describes a project with 20 dwellings in seven highly insulated 1 1/2 storely houses. The energy source for heating and warm water is Danish natural gas coming from the North Sea. There is a gasmeter and a gasfired boiler for each dwelling. Some of the dwellings are very small, and the various types are further mixed in such a way that the project shows vertical party walls as well as floors designed to function also as "party walls". The above programme has required a special design effort with regard to structural solutions and design details. The report shows all the most important design cetails in the project, including gas installations. Energy consumption has been measured over two years and is also desribed. The houses can be considered to be so-called low energy houses.

45662 **(SBI-R—186) Electricity consumption in schools.** Aggerholm, S. Christiansen, J. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1987. 48p. (In Danish). Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm.

EFP-84.

The aim of the project, described in this report, has been to investigate the possibilities for savings in electricity consumption by performing analyses of the electricity consumption in four schools having approximately the same number of pupils and use. The investigation shows a major variation in the total electricity consumption per square metre in the four schools. The reason for this is mainly due to the differences in design and control of the ventilation plants in the schools. At some of the schools a considerable reduction in electricity consumption can be obtained by checking maintenance, design, and control of the installations. It is essential to carry out energy management of the electricity consumption to be able to identify where an unnecessarily large consumption takes place and whether a change in installations to achieve reduction in electricity consumption is cost effective. (EG).

45663 **(TKK-KO/LVI—C29) Use of re-circulation air and the filtration of air.** Lehtimaeki, M.; Laitinen, R.; Viiki, R. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1986. 79p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752872.

The effect of air re-circulation and filtration on the concentration of indoor air impurities has been studied. The study was carried out by measuring the concentrations of air impurities and by using a new measuring technique, which is based on the use of aerosol particles as tracer. The properties of filters were studied both in laboratory and field-conditions. In these studies, the efficiency of mechanical filters and electrostatic precipitators were clarified. In addition to these studies, measurements with gas filters were carried out as well (Al/sub 2/O/sub 3/+KMnO/sub 4/-filter material). The technical characteristic of room air cleaners were measured in laboratory. The results indicate that the air re-circulation and filtrartion can be used in reducing the concentrations of indoor air impurities, provided that the efficiency of the filter is good and that the re-circulation air flow rate is high. The experimental results indicate that a reasonable approximation for the effect of re-circulation system, can be obtained by using a simple mathematical model and by determining the air flow rates and the efficiency of the filter. Also the natural decay rate of the impurity must be known. The use of re-circulation in reducing the fresh air flow is possible only if the filtration system is effective and reliable to all impurities determining the value of fresh air flow. On the other hand, there seems to be no hindrance to the use of re-circulation provided that the hygiene of the ventilation system is taken care of. Particle filters of a re-circulation system must have a high efficiency for submicrometer particles as well. This can be accomplished by means of mechanical filters or by electrostatic precipitators. It must, however, be emphasized that the careful maintenance of filters is of great importance. When choosing the filter to be used in re-circulation system, both technical and economical aspects should be taken into account.

45664 **Energy-efficient lighting system for television.** Cawthorne, D.C. (to Dept. of Energy, Washington, DC). US Patent 4,682,238. 21 Jul 1987. Filed date 29 Jan 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a television light intensity control system for a viewing area subjected to natural and controllable artificial light comprising: a television camera comprising: transducer means for converting light from the viewing area to a first signal representative of the intensity of the light; and an optical system for transmitting light from the viewing area into the camera, the system including optical control means for automatically controlling from a maximum value to a minimum value the ratio of light passing from the optical system to light incident upon the optical system; lamp means for providing the artificial light over the viewing area; and lamp control means for using the first signal from the transducer means to control the intensity of artificial light from the lamp means to provide only sufficient artificial light as needed to keep the total of artificial and natural light leaving the optical system at a constant intensity, the artificial light is provided while the ratio of the optical control means is a substantially maximum value. The constant intensity is sufficient for the camera to generate a television video signal representative of a satisfactory television picture.

45665 **Performance of ejector heat pumps.** Chen, F.C.; Cheng-tsang Hsu. (Oak Ridge National Lab., TN, USA; Tennessee Univ., Knoxville, USA. Dept. of Mechanical and Aerospace Engineering). *International Journal of Energy Research;* **11**: No. 2, 289-300(Apr-Jun 1987).

An ejector-compression heat pump can use low-grade thermal energy in the neighbourhood of 93.3°C (200°F) to provide space cooling and heating. This paper applies the existing ejector theory to estimate the performance of an ejector heat pump system at various operating conditions. The study includes parametric, sensitivity and off-design analyses of the heat pump performance. The performance enhancement options and desired ejector geometry are also examined. Refrigerants 11, 113 and 114 are three of the halocarbons most suitable for the ejector heat pump system. The estimated coefficients of performance for a simple ejector heat pump are 0.3 for the cooling mode and 1.3 for the heating mode at a sample operating condition in which the refrigerant (R-11) boiling temperature is 93.3°C (200°F), condensing temperature 43.3°C (110°F) and evaporating temperature 10°C (50°F). A 24 percent performance improvement is predicted for a heat pump with two-stage ejectors and regenerative heat exchangers. The off-design performance is relatively insensitive to the evaporator temperature variations.

45666 **The residential energy audit manual.** Atlanta, GA; Association of Energy Engineers (1985). 486p. Association of Energy Engineers, 4025 Pleasantdale Rd., Atlanta, GA 30340.

This manual offers an approach to the residential energy audit prepared by energy specialists from Oak Ridge National Laboratory, Solar Energy Research Institute, University of Massachusetts and the U.S.D.O.E. which illustrates step by step how to perform an energy audit of any home. Subjects include measurements, calculations and all aspects of the audit, including construction considerations, mechanical, HVAC, electrical and furnace audit techniques as well as discussion of residential solar and wind energy systems.

3202 Transportation

REFER ALSO TO CITATION(S) 45306, 45537, 45696, 45707

45667 **(AD-A—181645/3/XAB) Fuel-conservation evaluation of US Army helicopters. Part 6. Performance calculator evaluation. Final report for period ending January 1981.** Dominick, F.; Lockwood, R.A. (Army Aviation Engineering Flight Activity, Edwards AFB, CA (USA)). Jul 1986. 205p. (USAAEFA—81-01-6). NTIS, PC A10/MF A01.

See also Part 5, AD-A128 532.

The US Army Aviation Engineering Flight Activity conducted an evaluation of Flight Management Calculator for the UH-1H. The calculator was a Hewlett-Packard HP-41CV. The performance calculator was evaluated for flight planning and in-flight use during 14 mission flights simulating operational conditions. The calculator was much easier to use in-flight than the operator's manual data. The calculator program needs improvement in the areas of pre-flight planning and execution speed. The mission flights demonstrated a 19% fuel saving using optimum over normal flight profiles in warm temperatures (15°C above standard). Savings would be greater at colder temperatures because of increasing compressibility effects. Acceptable accuracy for individual aircraft under operational conditions may require a regressive analog model in which individual aircraft data are used to update the program. The performance data base for the UH-1H was expanded with level flight and hover data to thrust coefficients and Mach numbers to the practical limits of aircraft operation.

45668 **(NP—7770260) Contribution to the optimization of decision making within pavement management with regard to aspects relevant to energy economy.** Breiter, B. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Fachbereich Bauingenieur- und Vermessungswesen). 2 Apr 1986. 348p. (In German). NTIS (US Sales Only), PC A15. File Number DE87770260.

Practical road maintenance has so far been relying on individual experiences when confronted with operational, technical or stratetical decisions. Reasonable, well-founded decisions resulting in the optimal use of energy sources and an optimization of the decision making within pavement management ought to be based on the results of studies assessing the situation of energy economy with particular regard to constructional demands and road user demands. The study deals with the basic situation of energy economy, decision making within pavement management and the basic principles of energy demand calculations. Apart from energy consumption values the study contains recommendations designed for the optimization of decision making within pavement management. Considerable potentials of energy conservation could be assessed to the benefit of the road user both with respect to highways and express highways. Provided that the road condition is kept at a high level by permanent maintenance in due time these potentials can be made use of. (orig./HSCH).

45669 **(PB—87-203220/XAB) High-occupancy vehicle treatments, impacts, and parameters (a synthesis). Volume 2. Bibliography and data. Final report.** Batz, T.M. (New Jersey Dept. of Transportation, Trenton (USA). Div. of Research and Demonstration). Aug 1986. 181p. (REPT—86-017-7767-2). NTIS, PC A09/MF A01.

See also Volume 1, PB—87-203212.

This report details the findings of 256 past and present high-occupancy vehicle (HOV) treatments that have been implemented. Volume I contains the procedures followed and the major conclusions found concerning the 19 specific HOV treatment types which were studied. Volume II contains a comprehensive bibliography along with a listing for each HOV treatment cited which includes the year implemented, size, priority cutoff, hours of operation, current status, and any before and after data concerning the impacts which the treatments may affect.

45670 **(UCRL—15933) Lawrence Livermore National Laboratory: Transportation and vehicle utilization study.** (Bechtel National, Inc., San Francisco, CA (USA); Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87014257.

This report is an investigation of vehicle use at Lawrence Livermore National Laboratory (LLNL). The LLNL vehicle fleet is described and categorized. Travel patterns are identified in and around the facility. Costs of the present transportation system and alternatives are analyzed. Recommendations for economizing use of the LLNL vehicle fleet are given. (JDH)

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 44883, 44961, 45194, 45196, 45197, 45544, 45559, 45562, 45591, 45658, 45685, 45766, 45900, 46043, 46224

45671 **(DOE/CE/15231—T6) [Method and means for preventing frost damage to crops]: Final technical report.** (Reich (Douglas R.), North Fort Myers, FL (USA)). 1987. Contract FG01-85CE15231. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014190.

This report covers the activities regarding the design, construction and testing of the REICH Heater for providing frost protection to crops. The report covers the following grant objectives: Redesign and fabrication of an improved version of the REICH Heater, modification of existing field test facilities at the University of Florida, testing an upgraded version of the REICH Heater under actual field conditions, and design of a production version of the REICH Heater. A statement is included covering the present status of the "commercialization" of the REICH Heater.

45672 **(DOE/ID/12302—7) Fluidized-bed waste-heat recovery system development: Semiannual report, August 1, 1984-January 31, 1985.** Cole, W.E.; Patch, K.D. (Thermo Electron Corp., Waltham, MA (USA)). Mar 1987. Contract FC07-81ID12302. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87014461.

A major energy loss in industry is the heat content of the flue gases from industrial process heaters. One effective way to utilize the energy is to preheat the combustion air for the process heater. The Fluidized-Bed Waste-Heat Recovery (FBWHR) System is designed to preheat this combustion air using the heat available in dirty flue gas streams. In this system, a recirculating medium is heated by the flue gas in a raining bed. The hot medium is then removed from the bed and placed in a fluidized bed where it is fluidized by the combustion air. Through this process, the combustion air is preheated. The cooled medium is then returned to the raining bed. Initial development of this concept is for the aluminum smelting industry. In this report, the accomplishments of the preceding six-month period are described. Specifically, tests in the laboratory FBWHR system, performing integrated system testing and subsystem development, were completed.

45673 **(DOE/ID/12302—8) Full-scale design of a fluidized-bed waste-heat recovery system: Topical report.** Patch, K.D.; Cole, W.E.; Shimko, M.A. (Thermo Electron Corp., Waltham, MA (USA)). 30 Jan 1987. Contract FC07-81ID12302. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87014457.

A major energy loss in industry is the heat content of the flue gases from industrial process heaters. One effective way to utilize the energy is to preheat the combustion air for the process heater. Fluidized-Bed Waste-Heat Recovery (FBWHR) System is designed to preheat this combustion air using the heat available in dirty flue gas streams. In this system recirculating alumina particles are heated by the flue gas in a raining bed. The hot particles are then removed from the bed and placed in a fluidized bed where they are fluidized by the combustion air. Through this process, the combustion air is preheated. The cooled particles are then returned to the raining bed. Initial development of this concept is for the aluminium smelting industry. In this report, the design of a full-scale FBWHR system is detailed. Specific work consisted of characterizing the host site aluminum smelting furnace chosen to receive the system; completing the system mechanical design; and integrating the system process control and instrumentation.

45674 **(DOE/ID/12303—5) Fluidized bed waste heat recovery system: Annual report, March 1, 1985-November 30, 1986.** Hoffman, L.C.; Williams, H.W.; Kreeger, A.H. (Aerojet Energy Conversion Co., Rancho Cordova, CA (USA)). Jun 1987. Contract FC07-81ID12303. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87014459.

During this period the advanced, self-cleaning waste heat boiler intermittently operated at the aluminum Melting Furnace No. 34, ALCOA, Massena, NY site. Hot (2200°F), dirty, aluminum melter waste stack gas is used by the FBWHRS to generate plant steam. Several development problems were encountered and overcome. Checkout, development testing and a twelve month Evaluation Test was conducted from 31 May 1985 through 31 May 1986. Operation of the FBWHRS by ALCOA is expected to continue for at least a decade before major overhaul and component replacement would be required. Self-cleaning characteristics of the FBWHRS at ALCOA were demonstrated operating on dust laden exhaust gas. Peak fuel energy savings for this size unit is projected at about 3870 kW (13.2 million Btu h) for installations with central steam fired boiler efficiencies of 75%. Fuel savings typically is 85 to 90% of the energy entering the unit. Energy savings are at a rate of over 51 billion Btu per year for a typical aluminum scrap melter furnace. This is equivalent to generating over 44 million pounds per year of 175 psig steam. Replacing natural gas at $4.14 per MM Btu in an 85% efficient conventional boiler represents a fuel savings of about $250,000 per year.

45675 **(GB—95) Results of a survey on fuel choice in industry.** Skea, J. (Sussex Univ., Brighton (UK). Science Policy Research Unit). Jun 1986. 29p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The aim of the Fuel Choice survey was to find out about attitudes and approaches to fossil fuel (ie excluding electricity) switching in UK industry; about recent fuel switches which have been made and the reasons which underlie them; and about future fuel switching intentions. The latter is now of great importance to UK energy suppliers because shrinking energy markets have promoted greater competition between the fuel industries and because the industrial market is perceived as being very responsive to changing fuel price relativities. Mainly the large energy consumers who account for the major share of UK industrial fuel use were surveyed -the sample was not intended to be fully representative. The main part of the survey was carried out in the autumn of 1985. A telephone follow-up was conducted in May and June 1986 to assess the impact of lower oil prices.

45676 (IMechE—1987-4, pp 123-129) **Motor and turbine as co-drivers.** Bertele, O.V. (Imperial Chemical Industries Ltd., Billingham, UK). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

The use of a variable speed high speed motor together with a passout turbine to drive a compressor is described. The reason for the selection for this drive arrangement and some of the limitations and difficulties experienced as well as operating experience are presented in this paper.

45677 (IMechE—1987-4, pp 131-136) **Energy saving with electrical variable speed drives.** Finney, D. (General Electric Co. Ltd., Rugby, UK). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

During the past 20 years considerable improvements have been made in Electrical Variable Speed Drives and their capital cost is now a fraction of the cost of the energy consumed by the drive. The traditional methods of controlling fluid flow rates by using valves and dampers is not appropriate to this age of high energy costs and more efficient ways are needed. The energy and cost savings which can be made by using variable speed drives to optimise the process flow rates and obtain flexibility in plant operation are discussed.

45678 (IMechE—1987-4, pp 193-205) **Improvement of the efficiency of double-suction high-power centrifugal pumps.** Saxena, S.V. (Thyssen Maschinenbau GmbH, Ruhrpumpen, DE). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

The power input of large pumps like pipeline pumps is about 0.5 to 10 MW. At an energy price of 0.125 DM/kWh and about 8000 hours of operation per year, this results in energy costs of 0.5 to 10 million DM per year for one pump. It is essential, that peak efficiences will be achieved. This does not only apply to the main duty point, but also to cases, where the duty point has been changed because of altered operating conditions, which often occurs in pipelines. Two pumping plants, in which significant changes of the operating conditions had to be overcome are described. By application of specially adapted impellers remarkable savings of energy have been achieved. This was possible without any change on the casings of the pumps, so that the original duty point can be restored by reinserting the original impeller.

45679 (IMechE—1987-4, pp 219-224) **Power recovery in process plants using Radial Inflow Turbines.** Ershagi, B.; Cooney, D.P. (Atlas Copco GPS Inc., California, US; Atlas Copco Airpower, Antwerp, BE). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

Energy saving Radial Inflow Turboexpanders are well adapted to provide profitable applications for the user. This turbomachinery design has been constantly refined over the past twenty years, yielding improved efficiency and mechanical soundness. Today's state-of-the-art designs make Turboexpanders quite acceptable for power recovery applications.

45680 (IMechE—1987-4, pp 225-230) **Problems in the application of gas turbines for co-generation.** Wong, W. (Bechtel Great Britain Ltd., London). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

Gas turbine and boilers may well be well proven components in themselves, but when combined into a system, they can give rise to problems due to incompatible characteristics. Gas turbines are not designed specifically to provide a uniform exhaust flow of hot gas. Boilers and their burner systems require uniform air flow. Design problems encountered in a co-generation plant required for producing 35 MW of electrical power and 180,000 kg/hr of steam at 42 bar are considered.

45681 **(NEI-FI—21) Present level of electricity consumption in wood handling facilities of the Finnish wood processing industry and an estimation of saving potential and possibilities of making the consumption more even.** Antonius, L. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 18 Nov 1986. 30p. (In Finnish). (TK—65673-02). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752871.

The present level of power consumption in wood handling facilities of the Finnish wood processing industry was investigated by sending questionaries to all pulp and paper mills and to the biggest sawmills, plywood mills and particle board mills in Finland. The answers represent about 60% of the total wood raw material consumption in the pulp and paper industry. With regard to sawmills, plywood mills and particle board mills the share of the corresponding wood amount is about 20% of the whole sector. The specific average power consumption in different wood handling facilities is: Pulp and paper mill with chip preparation 12.3. kWh/s-m"3; Pulp and paper mill without chip preparation 6.3 kWh/s-m"3; Sawmills 3 3.9 kWh/s-m"3; Particle board and plywood mills 8.6 kWh/s-m"3. However, there is a substantial variation in power consumption between different mills even in the same branch of industry. According to the average figures the whole Finnish wood processing industry consumed about 509 GWh for raw wood handling in 1985, corresponding to an average load of about 60 MW. The estimated saving potential by modernizing the raw wood handling facilities is 100 GWh/a for the whole industry.

45682 **(NP—7770262) Economic evaluation of power plant waste heat utilization in hortithermal greenhouses.** Batkiewicz, R. (Technische Univ. Muenchen, Freising (Germany, F.R.). Lehrstuhl fuer Wirtschaftslehre des Gartenbaues). 1985. 238p. (In German). NTIS (US Sales Only), PC A11. File Number DE87770262.

The drastic rise in energy prices has severely been affecting the greenhouse horticulture of the Federal Republic of Germany. A profitable future greenhouse horticulture therefore calls for the use of lower-cost energy sources. The study abstracted is dedicated to the establishment of an economically founded decision in favour of or against either a hortithermal greenhouse supplied by power plant waste heat or primary energy greenhouses relying on heat from fossil fuels, i.e. a decision between waste heat and fossil fuel energy sources. Research work was based on a collection of data published by the horticultural management workshop (Arbeitskreis Betriebs-

wirtschaft im Gartenbau). The decision to be found was assumed to be applying to uncertain future prospects. Separate chapters are devoted to the following subjects: - preselection of optimal hortithermal and primary energy sites, - extension of individual planning models, - calculation of investment alternatives based on quasi-reliable data. (HAG).

45683 **(PB—87-204418/XAB) Evaluation of combustion processes for destruction of organic wastes - General Portland. Air pollution test report.** Jenkins, A.C. (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). 15 Oct 1985. 148p. (ARB/SS—87-02). NTIS, PC A07/MF A01.

The effects of burning organic-waste products in existing cement-kiln combustion systems have not yet been fully characterized. Changing customary fuels such as oil, coal, or coke by the addition of refractory or halogenated organic materials could possibly affect the nature of nitrogen oxides (NOx), sulfur oxides (SOx), carbon monoxide (CO), and particulate matter emissions. Additionally, the products of incomplete combustion of organic wastes under some conditions may be of a nature that would produce unacceptably hazardous emissions. The test results indicate that criteria pollutant emissions were not significantly changed under conditions of poor supplemental fuel atomization, with liquid supplemental fuels of low heating value, or with a supplemental fuel of higher chlorine content. Combustion under conditions of low excess air (1%) can result in an increase in both CO and SO_2 emissions.

45684 **(PB—87-208955/XAB) PIC (products of incomplete combustion) analysis methods. Final report, March 1984-April 1985.** James, R.H.; Farr, L.B.; Adams, R.E.; Miller, H.C. (Southern Research Inst., Birmingham, AL (USA)). Jun 1987. 530p. (SORI-EAS—86-1142). NTIS, PC A23/MF A01.

The report gives results of method evaluations for products of incomplete combustion (PICs): 36 proposed PICs were evaluated by previously developed gas chromatography/flame ionization detection (GC/FID) and gas chromatography/mass spectroscopy (GC/MS) methods. It also gives results of method evaluations of 59 additional principal organic hazardous constituents (POHCs) from the amended list of compounds from Appendix VIII of 40 CFR, Part 261. The report contains chromatograms, bar-graph mass spectra, and calibration curves for each compound. Relative retention times, detection limits, precision data, and mass spectra are tabulated for each compound. The report also reviews recent literature on the formation of PICs.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 45544, 46042, 46168

45685 **(EPRI-CS—5373) Wastewater reuse as cooling-tower makeup: Final report.** Goldstein, D.; Wei, I.; Casana, J. (Water General Corp., Lexington, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 94p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920570.

The objectives of this program are to document electric utility experience and concerns on the use of municipal wastewater as makeup to cooling towers and to identify areas lacking sufficient information for their application as well as to identify problem areas. Current users of municipal wastewater in electric utility cooling towers have been contacted and the literature has been reviewed. In addition, literature on the reuse of industrial wastewater has been reviewed. The findings are summarized in this report with emphasis on the use of municipal wastewater in electric utility cooling towers. It was found that this practice has been going on for sufficient time at sufficient places that the problems are fairly well understood. Scale formation by calcium phosphate is a problem. It is controlled by pH reduction or by removal of phosphate and suggested techniques are given. Fouling by slime is a problem. It is controlled by heavy doses of chlorine and other biocides or by mechanical and other non-chemical means without use of any biocide. Foaming, corrosion and blowdown disposal are not problems. There are a number of problem areas where more information is desired to establish a higher level of confidence in using sewage water as makeup. Three areas of research are recommended: (1) a study comparing the technological and environmental problems and costs of various technologies used to control the formation of biological slime, (2) laboratory and pilot scale testing to verify the prediction techniques for phosphate precipitation, and (3) to determine whether the health hazards of using sewage water are worse than the use of normal waters.

45686 **(KTM/E-B—53) Factors affecting the development of district heating activity.** Lehdonvirta, H. (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Nov 1985. 91p. (In Finnish). NTIS (US Sales Only), PC A05. File Number DE87752864.

The purpose of the study was to evaluate the development prospects of district heating and especially to figure out the impacts of certain factors on the development of district heating activity. The development prospects have been evaluated. The development is affected simultaneously by several factors, the impacts of which are diffucult to evaluate separately. The study performed includes, however, the following rough estimates about various factors' impacts on the district heat supply in the year 2000: 1) The impact of the decrease in the specific heat consumption on the competitiveness of district heating 0.1-0.3 TWh/a 2. The impact of the price development of heavy fuel oil on the initiation of district heating 0.2-0.4 TWh/a and extension of district heating 0.1-0.2 TWh/a 3. The impact of the alternative use of electricity and fuels on the initiation of district heating 0.2-0.4 TWh/a and extension of district heating 0.2-0.6 TWh/a 4. The impact of the good competitiveness of electric heating 0.4-1.1 TWh/a. The total impact is thus 1.2-3.0 TWh/a. The above factors would reduce the yearly district heat supply by an amount of 1.2-3.0 TWh in 2000. The impact is directed in pacticular to small localities and single houses, where the competitiveness of district heating is a it's weakest. According to the study, almost half of the building volume connected to district heating in 1990 consists of apartment houses. The share of single houses is little, about 2%. The apartment houses are still the most important group also as far as the extension of district heating is concerned, even if the industrial and business premises have an impact of almost the same extent. During the time period from 1980 to 2000 two thirds of the increase in building volume connected to district heating consists of new buildings and one third of old buildings shifting to district heating. The growth takes place mainly in the first half of the time period from 1980 to 2000.

45687 **(NP—7770261) Rapid calculation methods for the management of electric utilities.** Aschoewer, N. (Dortmund Univ. (Germany, F.R.). Abt. Elektrotechnik). 21 Jun 1985. 153p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770261.

Due to the administrative overload of electric power supply computers there is only little time left for network calculations. It is for this reason that the optimal management of electric utilities calls for rapid calculation methods. The publication abstracted describes and practically applies independent calculation methods with particular regard to the physical conditions accompanying them. It deals with the following subjects: - description of a stationary network model, - topological assessment of the present condition of the network, - physical conditions, - determination of a consistent data record, - rapid independent load analysis, - overall and independent sensitivity analysis, - (n-1) breakdown simulation, - adaptive assessment of disturbances, - numerical examples of breakdown simulations. (HAG).

45688 **(NP—7770263) Optimization of dual-purpose power plant organization - a contributing study.** Freimann-von Werder, W. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 19 - Elektrotechnik). 1 Nov 1985. 137p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770263.

The publication abstracted aims at optimizing the conversion of primary energy into electric power and thermal energy. Priority is given to the minimisation of the primary energy consumption. Moreover, the study discusses the co-operative relation between the electric utilities and users with respect to the balancing of electric

power supply and demand. The city of Berlin examplifies the availability of decentralised cogeneration systems. Separate chapters are dedicated to the following subjects: - integrated electric systems answering the requirements of the market, - integration of decentralized dual-purpose power plants, - optimal process control of dual-purpose power plants. (HAG).

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 45551

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 45563

45689 **(N—87-24985) Experimental study of laser-supported plasmas for laser propulsion: Center director's discretionary fund project DFP-82-33. Final report.** Eskridge, R.H.; Mccay, T.D.; Vanzandt, D.M. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Jan 1987. 32p. (NASA-TM—86583; NAS—1.15:86583). NTIS, PC A03/MF A01.

The rudiments of a rocket thruster, which receives its enthalpy from an energy source which is remotely beamed from a laser, is described. An experimental study, now partially complete, is discussed which will eventually provide a detailed understanding of the physics for assessing the feasibility of using hydrogen plasmas for accepting and converting this energy to enthalpy. A plasma ignition scheme which uses a pulsed CO_2 laser was develped and the properites of the ignition spark documented, including breakdown intensities in hydrogen. A complete diagnostic system capable of determining plasma temperature and the plasma absorptivitiy for subsequent steady-state absorption of a high power CO_2 laser beam are developed and demonstrative use is discussed for the preliminary case study, a two atmosphere laser supported argon plasma.

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 44984, 45015, 45310, 45310, 45707

45690 **(AD-A—181273/4/XAB) Exploratory development of a twin-spool turbocharger for a high-output diesel engine. Final report, September 1983-June 1986.** Hess, R.; King, J.F.; Harp, J.L. (Thermo Mechanical Systems Co., Canoga Park, CA (USA)). Aug 1986. 127p. (SR—41). NTIS, PC A07/MF A01.

The analysis, design, fabrication, and experimental testing of a twin-spool turbocharger was conducted for the Cummins NTC-475 diesel engine. Two major designs of the twin-spool turbocharger were fabricated and tested: 1) Compact design, concentric shaft-to-shaft bearing coupled turbocharger incorporating a) split 40° backswept impeller, b) split AiResearch Ti8A85 turbine rotor, c) adjustable vaned compressor diffuser, and d) nozzleless AiResearch turbine (volute) housing; and 2) Independently supported (shafts dynamically de-coupled) concentric shaft design incorporating a) separate structures for bearing support of the inner shaft b) split 25° backswept compressor impeller, c) split T18A40/Ti8A85 turbine rotor/exducer combination, and d) divided volute, adjustable-nozzle turbine housing. While bench tests were performed on both designs, engine testing was successfully carried out using the latter designs. Tests indicated that the second twin-spool configuration gave performance comparable to the originally equipped two-stage turbocharger system of the NTC-475 diesel engine (rated BHP of 425 hp at 2100 RPM, best BSFC of 0.35 at engine lug) with the added benefit of extending engine lugging range to 1200 RPM (from 1300 RPM, as originally equipped). This configuration gave peak compressor efficiency of about 75% and peak turbine efficiency of about 80%, both attributed to the reduction inducer angle of attack and exducer exit swirl angle made possible by the twin-spool concept.

45691 **(AD-A—181287/4/XAB) Microsensor monitoring of engine lubricants for fuel dilution and water content. Memorandum report, April 1984-October 1986.** Bolster, R.N. (Naval Research Lab., Washington, DC (USA)). 20 May 1987. 25p. (NRL-MR—5961). NTIS, PC A02/MF A01.

A laboratory device was developed to examine diesel-engine lubricants for fuel dilution. Samples of 25 microliters were heated in flowing air, and the volatiles evolved detected with a calibrated electronic sensor. With suitable temperatures and flow rates, determined from tests of typical lubricants and fuels, dilution of 1% was readily detectable. The quantitative precision of the method was affected by the varied oil volatilities, but was limited by the stability of the semiconductor sensor. Moisture sensitivity, flow-rate sensitivity, and slowness in returning to its baseline level after use were encountered. A surface-acoustic-wave fuel sensor might offer improved performance. The detection of small quantities of water in lubricants by this method is difficult, due to the small sample volume and interference by the organic vapors, but should be possible with sensors.

45692 **(AD-A—181753/5/XAB) Literature review of cetane number and its correlations. Progress report, July 1986-March 1987.** Pande, S.G. (Geo-Centers, Inc., Newton Upper Falls, MA (USA)). May 1987. 69p. (GC-TR—87-1628). NTIS, PC A04/MF A01.

This review covers the standard method of determining cetane number (engine tests, ASTM D613) and alternative methods, which comprise 1 engine-test method and 33 cetane indices (predictive equations of cetane number). Of the alternative methods, emphasis is given to those that appear or had appeared promising as good predictors of cetane number. The various cetane indices are categorized according to the type of parameters employed viz, physical properties (e.g., the calculated cetane index, ASTM D976, an approved alternative method to ASTM D613), chemical composition/structure, and physico-chemical properties (e.g., spontaneous ignition tests). Of the physical properties, the combination of distillation temperature(s) and density appear to afford good correlations between cetane index and cetane number. Furthermore, these two parameters continue to feature in the replacement equations of D976. For indices based on a single property, aniline point gives the best prediction.

45693 **(CONF-870762—Absts.) Coatings for advanced heat engines workshop: Book of abstracts.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems). 1987. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012623.

From Coatings for advanced heat engines workshop; Castine, ME, USA (27 Jul 1987).

This report is a collection of abstracts dealing with topics in internal combustion engine research. Subjects covered include: diesel and gas turbine engine research, adiabatic and low heat rejection diesel engines, thermal barrier coatings, tribology, ceramics, and combustion and emission research. (JDH)

45694 **(DOE/AL/38221—T2) Experimental validation of a zero-dimensional computer model for spark-ignition engines: Progress report.** Scott, R.L. Jr. (Southern Univ., Baton Rouge, LA (USA). Dept. of Mechanical Engineering). 30 Jul 1987. Contract AS04-86AL38221. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013102.

This report gives progress made on design of a one cylinder spark ignition engine and validation of its zero-dimensional computer model. Measuring instruments were installed on the engine and tested. Some data are presented comparing experimental and computer calculated measurements. (JDH)

45695 **(DOE/CE/50052—H1) Pollutant formation in heterogeneous mixtures of fuel drops and air.** Lefebvre, A.H. (Purdue Univ., Lafayette, IN (USA). School of Mechanical Engineering). May 1987. Contract FG01-84CE50052. 248p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87013577.

A unique spray combustion apparatus is developed to provide a better understanding of the basic role of fuel chemistry in determining the amount and nature of pollutant emissions from gas turbine and diesel engines. Fuel is supplied to the flame zone through a circular array of 30 miniature airblast atomizers. The objective is to achieve a sensibly uniform mixture strength in the fuel-air mixture entering the flame zone. This, in turn, ensures uniform conditions of temperature and chemical composition at any given axial distance downstream of the fuel injection plane. A unique feature of this fuel injection system is that it allows the mean drop size of the fuel spray to be varied while maintaining all other flow properties constant. Thus, experimental data concerning pollutant emissions can be acquired under controlled conditions of pressure, inlet air temperature, and fuel mean drop size, at any given axial distance downstream of the fuel injection plane. This means that all observed differences in pollutant formation can be attributed directly to variations in chemical properties. Data are presented to show the effects of variation in inlet air temperature, pressure, fuel-air ratio, fuel drop size, and fuel chemistry on pollutant emissions, with special emphasis on particulates. 175 refs., 120 figs.

45696 **(DOE/CS/50028—T1) Alternative fuels performance and emissions characteristics.** Swain, M.R.; Swain, M.N.; Blanco, J.A.; Adt, R.R. Jr. (Miami Univ., Coral Gables, FL (USA)). Jan 1987. Contract AS05-80CS50028. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013055.

This report addresses the question of what problems might be caused by the use of non-petroleum based gasolines in a standard throttle body fuel injection closed-loop spark-ignition internal combustion engine. Five fuels were tested in five separate but physically identical engines. The five fuels were, one baseline unleaded gasoline, two oil shale-derived gasolines, and two coal-derived gasolines. The basic testing of a fuel centered around a 5 hour cycle which was repeated daily until 200 hours of operation were accumulated. The 5 hour cycle was run by alternating every 15 minutes between two distinct conditions. During the accumulation of the 200 hours of operation, the engines were disassembled and inspected nine times. Additionally, thermal efficiency, regulated emissions, unburnt hydrocarbon makeup, catalyst pressure drop, and cylinder pressure versus crankshaft position measurements were made. Negligibly small differences were recorded in the behavior of the fuels, in terms of brake thermal efficiency, regulated emissions, effect on oxygen sensor life, and effect on catalyst life. Noteworthy differences in individual unburnt hydrocarbon concentration in the exhaust were recorded. Noteworthy differences in the behavior of the fuels in terms of producing deposits that caused intake valve sticking are presented in this report. Additionally, the fuels behaved differently when operated in the presence of knock producing deposits. (R+M)/2 octane numbers proved to be a poor indicator of the fuels knocking behavior. R-M octane numbers proved to be a better indicator of knocking behavior. 16 refs., 43 figs., 29 tabs.

45697 **(DOE/NASA—0030-2) Experimental evaluation of chromium-carbide-based solid lubricant coatings for use to 760°C.** Della Corte, C. (Case Western Reserve Univ., Cleveland, OH (USA)). Aug 1987. Contract AI01-86CE50162. 44p. (NASA-CR—180808). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014296.

This paper describes a research program to further develop and investigate chromium carbide based self-lubricating coatings for use to 760°C. A bonded chromium carbide was used as the "base stock" because of the known excellent wear resistance and the chemical stability of chromium carbide. "Additives" were silver and barium fluoride/calcium fluoride eutectic. The three coating components were blended in powder form, applied to stainless steel substrates by plasma-spraying and then diamond ground to the desired coating thickness. A variety of coating compositions was tested to determine the coating composition which gave optimum tribological results. Coatings were tested in air, helium, and hydrogen at temperatures from 25 to 760°C. Several counterface materials were evaluated with the objective of discovering a satisfactory metal/coating sliding combination for potential applications, such as piston ring/cylinder liner couples for Stirling engines. In general, silver and fluoride additions to chromium carbide reduced the friction coefficient and increased the wear resistance relative to the unmodified coating. The lubricant "additives" acted synergistically in reducing friction and wear. Several coating compositions gave good results in hydrogen, helium, and air to 760°C.

45698 **(LA-UR—87-2017) Evaluating and testing thermographic phosphors for turbine-engine temperature measurements.** Noel, B.W.; Allison, S.W.; Beshears, D.L.; Cates, M.R.; Borella, H.M.; Franks, L.A.; Iverson, C.E.; Dowell, L.J.; Gillies, G.T.; Lutz, W.N. . (Los Alamos National Lab., NM (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA); EG and G Energy Measurements, Inc., Las Vegas, NV (USA); Virginia Univ., Charlottesville (USA)). 1987. Contract W-7405-ENG-36. 18p. (CONF-8706157—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011772.

From 23. AIAA/SAE/ASME/ASEE joint propulsion conference; San Diego, CA, USA (29 Jun 1987).

A technique developed earlier for measuring the temperature of inaccessible surfaces in low-temperature rotating machines is being adapted to measure the temperature of surfaces at the higher temperatures and in the erosive environment inside operating turbine engines. The method uses the temperature dependence of the characteristic decay time of the laser-induced-fluorescence of thermographic phosphors to measure the temperature. This paper summarizes recent work in four areas: phosphor characterization and calibration, instrumentation development, bonding, and field tests. By using improved instrumentation and data-analysis techniques, calibration curves for several phosphors are measured with greater accuracy and extended to higher temperatures than before. Phosphors are evaluated that were attached to sample surfaces by high-temperature bonding materials, electron-beam deposition, flame spraying, and plasma spraying. A burner rig test was performed on some phosphor-coated samples and the instrumentation required for an upcoming spin-pit test was designed, built, and calibrated.

45699 **(NYSERDA—87-17) Dual-fuel school bus demonstration: Final report.** (Mueller Associates, Inc., Baltimore, MD (USA)). Oct 1986. 159p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. File Number TI87900946.

This report describes the results of a demonstration of the capabilities of compressed natural gas (CNG) as an alternate fuel source for school bus fleets. Three New York State school districts participated in the demonstration project by converting ten buses each to dual-fuel capability. The buses could use both CNG and gasoline or CNG and diesel fuel. Each district also installed a CNG refueling station to serve their buses. School bus fleets were chosen because of their large fuel use, advantageous usage patterns and the benefits which would accrue from reduced fuel costs. The report includes both quantitative and qualitative data summarizing bus fuel enonomy; bus maintenance costs; refueling station operating and maintenance costs; regulatory problems; safety; training and community acceptance. 41 figs., 29 tabs.

45700 **(PB—87-197422/XAB) Effect of an emergency light diesel fuel on the performance and durability of an ADE (Atlantis Diesel Engine) 236 diesel engine operating with retarded-injection timing. Research report.** Myburgh, I.S.; Falk, R.S. (National Mechanical Engineering Research Inst., Pretoria (South Africa). Heat Mechanics Div.). Sep 1985. 67p. (CSIR-RR—614). NTIS, PC PC E06/MF E07.

North American Continent sales only.

Owing to the energy crisis in the 1970's and to the fact that the demand for diesel continues to grow more rapidly than the demand for petrol, the Heat Mechanics Division of the National Mechanical Engineering Research Institute has investigated a number of fuels that could be blended with diesel at the refinery to extend diesel. These fuels were mainly lighter hydrocarbons and included heavy naphtha and petrol. The fuels blended from these light hydrocarbons and diesel were consequently called light diesel fuels. The report describes the results of a durability test carried out on a diesel engine which is known to be sensitive to off-specification diesel fuels. A light diesel fuel of similar specification to that formulated by the oil companies was used.

45701 **(PNL—6210) Japanese industrial research on lean combustion: A case study: International Research Monitoring Program.** Hane, G.J.; Hutchinson, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013839.

In recent years, Japanese automakers have introduced a number of successful lean-combustion engines. These engines, in addition to the general expertise in building small cars, have made the Japanese automobiles into the gas mileage champions of the US market. The lean-combustion engines also provide very satisfactory performance and acceptable emissions. United States automakers and research managers, who were probably better informed about lean-combustion than the Japanese were, actively investigated lean-combustion but did not develop an engine. This report examines the basis for the Japanese innovations, the research that took the Japanese past the US state of the art to permit engine development. A preliminary review of recent (1980s) Japanese literature did not turn up strong evidence of new research activity in the lean-combustion area, but did provide background on new engines developed by several major manufacturers. The study was conducted solely through the Japanese and US published literature, with emphasis on early research conducted in the 1970s. This report presents an example of how Japanese research progress can be examined by reviewing the Japanese research literature. Although useful information was obtained by this method, it is still difficult to get a complete picture. When reviewing the literature, as was done for this report, one must remember that the marginal use of references by Japanese researchers obscures prior work, as does the tendency of the Japanese to publish several articles on similar or identical topics. 50 refs., 15 figs.

45702 **Development of the AGT101 regenerator seals.** Fucinari, C.A.; Vallance, J.K.; Rahnke, C.J. New York, NY; American Society of Mechanical Engineers (1987). 10p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-173.

The design and development of the regenerator seals used in the AGT101 gas turbine engine are described in this paper. The all ceramic AGT101 gas turbine engine was designed for 100 hp at 5:1 pressure ratio with 2500F (1371C) turbine inlet temperature. Six distinct phases of seal design were investigated experimentally and analytically to develop the final design. Static and dynamic test rig results obtained during the seal development program are presented. In addition, analytical techniques are described. The program objectives of reduced seal leakage, without additional diaphragm cooling, to 3.6% of total engine airflow and higher seal operating temperature resulting from the 2000F (1093C) inlet exhaust gas temperature were met.

45703 **AGT101 - Ceramic gas turbine development.** Boyd, G.L.; Easley, M.L.; Kreiner, D.M. New York, NY; American Society of Mechanical Engineers (1987). 17p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-228.

A major technical effort has resulted in recent testing of the all-ceramic hot section in the DOE/NASA sponsored AGT101 Advanced Gas Turbine. This testing was preceded by critical component developments including ceramic structures design evolution to satisfactorily pass the peak stress start transients with 25-percent margin. The most challenging ceramic component, the turbine rotor, has undergone successful fabrication development, but further process and material development are necessary to meet the high temperature durability goals. The 100-hour engine test of the ceramic structures to 2100F (1149C), and the later 85-hour engine test of the all-ceramic hot section to 2200F (1204C) have been important program accomplishments. Full speed operation to 100,000 rpm and a ceramic rotor tip speed of 2300 ft/sec (701 m/s) has been demonstrated. The ability of these experimental gas turbines to operate in a regime where the unique properties of structural ceramics can be exploited offers the opportunity to further advance ceramic technology.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 45697, 45707

45704 **(PNL—6078) Stirling engine research at national and university laboratories in Japan.** Hane, G.J.; Hutchinson, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014622.

Pacific Northwest Laboratory (PNL) reviewed research projects that are related to the development of Stirling engines and that are under way at Japanese national laboratories and universities. The research and development focused on component rather than on whole engine development. PNL obtained the information from a literature review and interviews conducted at the laboratories and universities. The universities have less equipment available and operate with smaller staffs for research than do the laboratories. In particular, the Mechanical Engineering Laboratory and the Aerospace Laboratory conduct high-quality component and fundamental work. Despite having less equipment, some of the researchers at the universities conduct high-quality fundamental research. As is typical in Japan, several of the university professors are very active in consulting and advisory capacities to companies engaged in Stirling engine development, and also with government and association advisory and technical committees. Contacts with these professors and selective examination of their research are good ways to keep abreast of Japanese Stirling developments.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 45521, 45527

3307 Emission Control

REFER ALSO TO CITATION(S) 46160

45705 **(WSL-LR—564(AP)-M) Gaseous pollutant emissions of a 1.8 litre Volkswagen Scirocco without and with three-way catalyst systems.** Potter, C.J.; Savage, C.A. (Warren Spring Lab., Stevenage (UK)). May 1986. 32p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

The on-the-road emissions of a 1.8 l Volkswagen Scirocco have been measured using the Warren Spring Laboratory Mini-CVS system. The emissions were measured with the vehicle in three conditions: (i) no catalyst, (ii) a 50,000 mile aged catalyst and (iii) a 200 h aged catalyst. The road test schedule included urban, suburban, motorway drives and high speed drives on a test track.

45706 **(HSE-TR—11722) Use of advanced exhaust gas treatment devices.** Koberstein, E.; Engler, B.; Domesle, R.; Voelker, H. Translated from *VDI-(Verein Deutscher Ingenieure) Berichte ;* No. 559, 275-296(1985). 21p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Translated from German.

Through the use of advanced exhaust gas treatment devices on diesel engines, it is possible to reduce not only the gaseous pollutants but also, to a marked extent, the particulate emissions. A survey is presented of those catalytic techniques most frequently encountered in development studies, or which are in small-scale production at the present time, which involve monolithic ceramic supports. The mode of operation of the related catalysts is described, and the degree of exhaust gas purification achieved by this means is discussed.

3308 Alternative Fuels

45707 (DOE/CS/50075—H1) Transportation fuels and engines for optimum energy utilization: An assessment of energy consumption from resources through end use: Final report, Volume 1. Thomas, R.L.; Cornell, J.J. (AIChE Research Center for Energy and Engineering, Inc., Washington, DC (USA)). Aug 1985. Contract AC01-84CE50075. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013097.

This report presents an assessment of the potential energy savings that could accrue from the use of alternative fuels in future transportation engines. Alternative fuels are defined in this study as hydrocarbon fuels which possess characteristics that assure user safety and satisfaction, but require less energy to produce than conventional specification fuels produced from the same resource. In particular, the energy requirements for producing such fuels from domestic coal and oil shale resources are examined from the standpoint of their adaptability to engine types having a high potential for achieving significant efficiency gains over existing transportation engines. Incentives for specific types of engine development are identified in terms of energy savings above those obtainable with current specification fuels. While engine research and development incentives historically are based on economic trade-offs between the fuel and the engine, no attempt is made in this study to establish the costs of alternative fuels because of the many economic factors involved. Currently, approximately 50% of US petroleum consumption is used to fuel automotive engines for passenger car, bus, and truck transportation. Therefore, developments directed toward the use of more efficient engines that operate on alternative fuels will have a major impact on the future energy security of the US. 71 refs., 9 figs., 7 tabs.

45708 (ORNL/Sub—85-22007/1) Compendium of significant events in the recent development of alcohol fuels in the United States. Bechtold, R.L. (Mueller Associates, Inc., Baltimore, MD (USA)). Jun 1987. Contract AC05-84OR21400. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013355.

The objective of this compendium is to document the key events in the recent development of alcohol fuels in the United States, so as to provide insight into their evolution. While certainly having historical value, this compendium may also serve as a useful reference tool toward planning future alternative fuel efforts. The criteria used to determine whether an event would be mentioned in the compendium included: significant impact on the development of alcohol fuels; identification with a date or a narrow interval in time; and public knowledge, i.e., it was not an internal event known only to a select few which had not been reported to the public. Many of the technical advances made to use alcohols in vehicles are not represented because they did not meet one or more of the criteria. This deficiency was recognized and it is felt that a more appropriate approach for treating technical advances would be a report written in narrative style which documents those achievements. While all the events included in this compendium are believed to be accurate with regard to content and chronology, no attempt was made to assess whether a given event was positive or negative to the advancement of alcohol fuels. The relative value of each event is left for the reader to determine.

45709 (ORNL/TM—10435) Alternative fuels utilization program project office operation plan for FY 1986-87. Graves, R.L.; McGill, R.N. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013370.

Oak Ridge National Laboratory (ORNL) was assigned the responsibility of being field project office for the DOE Alternative Fuels Utilization Program AFUP in April 1984. This document is the second operating plan developed by ORNL for AFUP and reflects the general program philosophy and goals as described in the DOE Headquarters AFUP program plan. Current efforts in AFUP are largely focused on three fuel areas; new hydrocarbon fuels, synthetic fuels, and alcohol fuels. All projects either underway or planned for the near future are described in this report.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 45967, 46265

45710 (AD-A—181427/6/XAB) Space: the fourth military dimension. The Strategic Defense Initiative and the implications for land warfare in the twenty-first century. Final report. Harvey, J.V. (Army War Coll., Carlisle Barracks, PA (USA). Strategic Studies Inst.). 1 Oct 1986. 99p. NTIS, PC A05/MF A01.

This study considers space as the fourth and newest military dimension and examines the implications of space power and new technologies on land warfare to the mid-21st century. A resurgence of interest in military space operations among the senior leadership of the Army began around 1983. Studies had established that, while the Army was not fully exploiting the potential capabilities of space to support land combat, it was already deeply dependent on space systems. This dependence was increasing yearly without any planning having been done to evaluate its impact on future land-combat operations' overall goals and objectives for Army participation in space activities. The Army has begun to correct these shortcomings but many far-reaching decisions need to be made in the near future. This study examines some aspects of space which need to be considered in making these decisions as space systems become operational military systems. The author concludes that the Army does not have the qualified personnel or organizational structure to use space and space-based systems to their fullest potential. This is an immediate requirement, and meeting this challenge will greatly help in the longer-range requirements of assessing and incorporating military operations in space and space technologies into land warfare, preparing the Army to fight in a four-dimensional environment, and establishing the proper perspective in the Army for space operations.

45711 (AD-A—181608/1/XAB) Application of the Modular Command and Control Evaluation Structure to a Strategic Defense Initiative command and control system. Master's thesis. Kramer, G.K. (Naval Postgraduate School, Monterey, CA (USA)). Mar 1987. 92p. NTIS, PC A05/MF A01.

This thesis focuses on relating a generic evaluation structure, the Modular Command and Control Evaluation Structure (MCES), to the battle management (BM) and command, control and communication (C3) issues of the Strategic Defense Initiative (SDI). To do this, the area of SDI battle management, command and control (C2), and communications are reviewed and explained as well as the MCES. This provides useful descriptive analysis required for identifying and measuring proposed BM/C3 architectures.

3503 Verification

REFER ALSO TO CITATION(S) 45172

36 MATERIALS

REFER ALSO TO CITATION(S) 44859, 46343

45712 (CONF-870942—1) Advanced Research and Technology Development Fossil Energy Materials Program. Judkins, R.R.; Bradley, R.A. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02. File Number DE87013549.

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

The Advanced Research and Technology Development (AR and TD) Fossil Energy Materials Program is a multifaceted materials research and development program sponsored by the Office of Fossil Energy of the US Department of Energy. The program is administered by the Office of Technical Coordination. In 1979, the Office of Fossil Energy assigned responsibilities for this program to the DOE Oak Ridge Operations Office (ORO) as the lead field office and Oak Ridge National Laboratory (ORNL) as the lead national laboratory. Technical activities on the program are divided into three research thrust areas: structural ceramic composites,

alloy development and mechanical properties, and corrosion and erosion of alloys. In addition, assessments and technology transfer are included in a fourth thrust area. This paper provides information on the structure of the program and summarizes some of the major research activities.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 45114, 45314, 45335, 45339, 45340, 45341, 45423, 45423, 45424, 45424, 45425, 46022, 46023, 46091, 46139, 46725, 46730, 46745, 46746, 46747, 46748, 46749, 46750, 46756, 46759, 46760, 46761, 46765, 46806, 46912, 46974, 46974

45713 **(AD-A—181595/0/XAB) Effects of particle beams on materials. Final report for contract number N00014-85-C-2513.** (KM Sciences, Arlington, VA (USA)). 1987. 32p. NTIS, PC A03/MF A01.

During the period 13 September 1985 to 31 March 1987, KM Sciences furnished support to the radiation effects programs of the Radiation-Matter Interactions Branch of the Naval Research Laboratory in the areas of collecting, manipulating, analyzing, and displaying experimental data, in writing, modifying, converting, and extending computer codes for modeling physical phenomena and in graphical presentation of experimental data and result of computations. Two major tasks were supported: (1) computer simulation of the effects of particle beams on materials, and (2) experimental measurements of the effects of particle beams on materials.

45714 **(CONF-8709117—1-Draft) Industrial applications of ion implantation into metal surfaces.** Williams, J.M. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014059.

From 2. biennial international machine tool research forum; Chicago, IL, USA (1 Sep 1987).

The modern materials processing technique, ion implantation, has intriguing and attractive features that stimulate the imaginations of scientists and technologists. Success of the technique for introducing dopants into semiconductors has resulted in a stable and growing infrastructure of capital equipment and skills for use of the technique in the economy. Attention has turned to possible use of ion implantation for modification of nearly all surface related properties of materials - optical, chemical and corrosive, tribological, and several others. This presentation provides an introduction to fundamental aspects of equipment, technique, and materials science of ion implantation. Practical and economic factors pertaining to the technology are discussed. Applications and potential applications are surveyed. There are already available a number of ion-implanted products, including ball-and-roller bearings and races, punches-and-dies, injection screws for plastics molding, etc., of potential interest to the machine tool industry.

45715 **(DOE/ER/45257—2) Transients in elevated temperature crack growth.** Saxena, A.; Gieseke, B. (Georgia Inst. of Tech., Atlanta (USA). Fracture and Fatigue Research Lab.). May 1987. Contract FG05-86ER45257. 20p. (CONF-8710123—1). NTIS, PC A02. File Number DE87013189.

From International seminar on high temperature fracture mechanisms and mechanics; Dourdan, France (13 Oct 1987).

Transients which affect the crack growth behavior of metals at elevated temperature under cyclic and static loading are classified as (1) deformation transients which are present due to the relaxing crack tip stress fields during small scale creep and (2) damage or crack growth transients which are present during the period in which a steady-state damage state evolves at the crack tip starting from an initially undamaged state. It is shown using extensive amounts of creep and creep-fatigue crack growth data on 1Cr-1Mo-0.25V steel that deformation transients under static as well as cyclic loading are completely normalized by the C/sub t/ parameter. It is also shown that the other crack tip parameters such as K, C* and C(t) are unable to normalize the influence of deformation transients. However, C/sub t/ fails to uniquely characterize the crack growth rate during the damage or crack growth transient.

45716 **(DOE/ER/45310—3) On the search for experimentally observed grain boundary phase transitions.** Balluffi, R.W.; Hsieh, T.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jul 1987. Contract FG02-84ER45116;FG02-87ER45310. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012747.

The phase space for a heterogeneous system containing a grain boundary involves a relatively large number of variables (i.e., at least six plus the number of components), and it is therefore conceptually possible to induce a large variety of grain boundary phase transitions by selectively varying these parameters. Despite this, a review of the literature reveals that there have been virtually no clear-cut experimental observations of transitions reported in which the boundary structure has been observed as a function of time under well defined conditions. In current work, we are searching for roughening/faceting transitions and melting transitions for boundaries in Al by hot stage transmission electron microscopy. A clear example of a reversible roughening/faceting transition has been found. No evidence for melting has been found for temperatures as high as 0.96 T/sub m/ (by monitoring GBD core delocalization in several special boundaries with $\Sigma \leqq 13$) or 0.999 T/sub m/ (by observing the local diffraction contrast at general boundaries in polycrystalline specimens).

45717 **(DOE/ER/45310—4) Observations of localized grain boundary dislocations in series of [001] and [110] symmetrical tilt boundaries in aluminum.** Kvam, E.P.; Balluffi, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering; Liverpool Univ. (UK). Dept. of Materials Science and Engineering). 20 Aug 1987. Contract FG02-87ER45310. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014011.

The present results demonstrate the existence of localized GBDs in a number of near low-Σ $<100>$ and $<110>$ symmetric tilt boundaries in Al. These results suggest that extensive hierarchies of localized GBD structures exist in these series of boundaries similar to those found recently (3) in [001] symmetric tilt boundaries in Au. Presumably these additional structures could be revealed by further careful microscopy carried out on a wider sampling of boundaries. The results are consistent with the structural unit/GBD description of these boundaries. They are also consistent eith calculations for these symmetric boundaries which predict localized perfect GBDs having the shortest possible Burgers vectors normal to the boundary (and which also do not produce steps in the boundary).

45718 **(EUR—10682-EN) Guide to the control of high temperature corrosion and protection of gas turbine materials.** Morocutti, O. (ed.); Duret-Thual, C.; Morbioli, R.; Steinmetz, P. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92 - Chatillon (France)). 1986. 118p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Components of hot sections in gas turbines are subjected to severe thermomechanical cycles and operate in complex environments which depend on the type of machine and conditions of use. Environment-induced degradations if not controlled may cause a significant decrease in the components expected lifetime. The aim of this work is to show how to control hot corrosion processes or to decrease corrosion attack which affects these components. This report is directed to non-specialists. It is intended to give some basic knowledge on hot corrosion so that the users for instance can orientate themselves towards a solution and especially communicate in a meaningful way with specialists. It is based mainly on results collected from the 'COST' work, which represents about 12 years of collective effort of the European Communities in this field. The report covers the background to the problem, the description of the basic corrosion processes and the way to study them, the materials and coatings currently used for blades and vanes, the effect of environment and coating on components' mechanical properties and finally the prevention of corrosion and solutions for the future.

45719 (INIS-SU—423, pp 15-16) **Solution enthalpy of ytterbium and lutetium in germanium.** Nikolaenko, I.V.; Turchanin, M.A.; Batalin, G.I. (Kievskij Gosudarstvennyj Univ., Ukrainian SSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45720 (INIS-SU—423, pp 25-26) **Thermodynamic characteristics of aluminium-scandium and zirconium-silicon binary alloys.** Esin, Yu.O.; Valishev, M.G.; Litovskaya, V.V.; Gel'd, P.V.; Petrushevskij, M.S. (Ural'skij Politekhnicheskij Institute, Sverdlovsk, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45721 (INIS-SU—423, pp 44-45) **Formation enthalpy of alkaline earth metals with aluminium intermetallic compounds.** Dzhuraev, T.D.; Verbitskaya, N.A.; Bakhobov, A.V. (Institute Khimii, Dushanbe, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45722 (INIS-SU—423, pp 126-127) **Thermodynamic properties of HoBi and HoSb compounds.** Yamshchikov, L.F.; Raspopin, S.P.; Arkhipov, P.A. (Ural'skij Politekhnicheskij Institute, Sverdlovsk, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45723 (INIS-SU—423, pp 134-135) **Vaporization rate and thermodynamic properties of titanium and vanadium germanides.** Fesenko, V.V.; Timokhin, V.V.; Fomenko, V.V.; Lyashchenko, A.V.; Kornilova, V.I.; Podarevskaya, O.V. (Kievskij Tekhnologicheskij Institute Pishchevoj Promyshlennosti, Ukrainian SSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45724 **(Juel-Spez—373) Calculation of creep deformation and stresses in thick-walled pipes.** Breitbach, G.; Kragl, S.; Roedig, M.; Penkalla, H.J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Sep 1986. 60p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10621.

Heat exchangers for methane reforming processes which are installed in a helium-cooled high-temperature reactor may experience temperatures up to 800 or 950/sup 0/C. At such temperatures, creep in metallic structures is a phenomenon that requires full attention. The report explains methods of calculating stresses and creep deformation in thick-walled pipes subjected to pressure loads and superimposed axial loads. Norton's creep law is taken as the basic descriptive equation. The calculation methods applied are both exact (continuum mechanics) and approximative. The results of both calculation types for a series of examples are compared and discussed.

45725 **(KC—86/02d) Chloride induced corrosion of stainless steels and aluminium in condensing boilers.** Maahn, E.; Jansen, P. (Korrosionscentralen, Broendby (Denmark)). 1986. 34p. (In Danish). Korrosionscentralen, Park Alle 345, DK-2605 Broendby.

Roeggaskondensation. Rapport 4.; EFP-83.

Chloride from the combustion air has a decisive influence on the corrosion properties of aluminium and stainless steels. The critical concentration of chloride has been studied by electrochemical corrosion test methods for two high alloyed steels SS 2562 (904L) and Monit in condensate from an oil-fired boiler. The results show that SS 2562 is passive in H/sub 2/SO/sub 4/ up to a concentration of 10% at 50 deg. C. The presence of 2000 ppm Cl/sup -/ reduces the passivation significantly. Stable passivation is also found in this materiale at 80 deg. C up to 200 ppm Cl/sup -/. The Monit has exhibited stable passivation in 40% H/sub 2/SO/sub 4/ at 60 deg. C even in 2000 ppm Cl/sup -/. In condensate from gas-fired boilers, three aluminium materials and two stainless steels were studied. The results of these tests show pitting resistance for the aluminium materials Al 99.5 and AlMg 5, 3 times higher than for the AlSi 10. The critical chloride concentration was found to be dependent on the temperature and lies between 300 to 3000 ppm Cl/sup -/ for temperatures from 50 to 90 deg. C.

45726 **(KIYI—86-21) Interaction between defects and the formation of dissipative structures in irradiated impure crystals.** Selishchev, P.A.; Sugakov, V.I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1986. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703125.

A stability is investigated of space-homogeneous distribution of free and captured by saturated flows the interstices and vacancies in irradiated crystals taking into account the elastic interaction between defects. The homogeneous distribution at critical parameters is shown to be unstable in respect of the formation of periodic structure of defect density. The critical parameters are determined, the period of formed structure, its dependence on irradiation conditions (the rate damage, the temperature) and the crystal properties (impurity concentrations, elastic constants) are found. 10 refs.; 7 figs.

45727 **(LA—11038-MS) Machining lead wafers.** Schamaun, R.T. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014487.

Recently, MEC-6 machined some 4-inch-diameter lead wafers to precision tolerances. The tolerance on the wafer thickness was +-0.000080 inch. A diamond tool was used to machine the wafers on a Moore No. 3 lathe. This report discusses the methods used to machine the wafers, the fixtures used to hold the wafers, and the inspection methods and results.

45728 **(LA-UR—87-2260) Elastic moduli of copper under compression.** Straub, G.K.; Wills, J.M.; Wallace, D.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—62). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013137.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Starting with a description of the electronic structure of copper, we have studied the zero temperature elastic moduli to 1 Mbar. We have used an empty-core model pseudopotential for the conduction electrons, treated the d-electron interactions in tight binding theory, and calculated the elastic moduli and their volume and pressure derivatives. The results are compared with experiment and with Full Potential Linear Muffin-Tin Orbital (FPLMTO) bandstructure calculations for the elastic moduli and their pressure derivatives.

45729 **(N—87-23729) T55-L-712 turbine engine compressor housing refurbishment project. Final report.** Leissler, G.W.; Darling, C.; Gilchrist, G. (Sverdrup Technology, Inc., Cleveland, OH (USA)). May 1987. 23p. (NASA-CR—179624; E—3571; NAS—1.26:179624; AVSCOM-TR—87-C-20). NTIS, PC A02/MF A01.

A study was conducted to access the feasibility of reclaiming T55-L-712 turbine engine compressor housings with an 88 wt % aluminum – 12 wt % silicon alloy applied by the plasma spray processes. Tensile strength testing was conducted on as-sprayed and thermally cycled test specimens which were plasma sprayed from 0.020 to 0.100 in. Satisfactory tensile strength valves were observed in the as-sprayed tensile specimens. There was essentially no decrease in tensile strength after thermally cycling the tensile specimens.

45730 **(ORNL/M—398) Process and equipment capabilities materials joining laboratory, 1987.** Reed, R.W. Jr. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014534.

The Materials Joining Laboratory of the Metals and Ceramics Division has the capabilities and expertise to perform various types of joining emphasizing welding and brazing. Capabilities range from joining of heavy-section steels using a wide variety of welding technology to joining of small parts by brazing or welding. Expertise and facilities also exist for joining ceramic-to-ceramic or ceramic-to-metallic parts using brazing technology. In addition, a newly acquired plasma-spray system is available for coating research. With other laboratories and facilities within the Metals and Ceramics Division, a situation exists for extensive characterization of microstructure and properties of weldments. The Laboratory is fully equipped for the standard welding processes including gas tungsten arc, submerged arc, gas metal arc, and electroslag (ES). Specialized equipment includes pulsed and high-power continuous wave CO_2 laser systems, high-power electron beam welding machines, internal bore tube-to-tubesheet welding system, narrow gap SA welding system, Gleeble thermomechanical simulator, and sessile drop apparatus for braze alloy wetting studies.

45731 (PSD—87, pp vp) **Thermal equilibrium vacancies in metals.** Schaefer, H.E. (Stuttgart Univ., Germany, F.R.). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

45732 (PSD—87, pp vp) **Neutron embrittlement of reactor pressure vessel steels - a challenge to positron annihilation and other methods.** Brauer, G.; Popp, K. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden, German Democratic Republic). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

45733 (PSD—87, pp SL11) **Change of microhardness and study of defects in HPIB irradiated Al by PA method.** Pogrebnjak, A.D.; Ruzimov, Sh.M.; Klopikov, E.B. (Tomskij Politekhnicheskij Institute, USSR; Moskovskij Ehnergeticheskij Institute, USSR). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

45734 **(SAND—85-0776) Basic radiation effects in nuclear power electronics technology.** Gover, J.E.; Srour, J.R. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 160p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85017402.

An overview is presented of the effects of radiation in microelectronics technology. The approach taken throughout these notes is to review microscopic phenomena associated with radiation effects and to show how these lead to macroscopic effects in semiconductor devices and integrated circuits. Bipolar integrated circuits technology is reviewed in Appendix A. Appendix B gives present and future applications of radiation-tolerant microelectronics in nuclear power applications as well as the radiation tolerance requirements of these applications.

45735 **(SAND—87-0315C) Static magnetization and microwave loss in shock-modified ferrites.** Venturini, E.L.; Graham, R.A.; Morosin, B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—22). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012362.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

High-pressure shock loading of cubic nickel ferrite and hexagonal barium ferrite powders results in substantial residual strain, producing changes in the magnetic anisotropy through magnetostrictive coupling. Both the static magnetization and the absorption of microwaves are strongly altered in nickel ferrite, with somewhat smaller changes in barium ferrite.

45736 **(SAND—87-0768C) High velocity erosion of metal interfaces.** Bourcier, R.J.; Chhabildas, L.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—66). NTIS, PC A02/MF A01; GPO Dep. File Number DE87013937.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A unique impact recovery experiment in which a truncated right conic section of 4340 steel is shot through a matching hole in a multi-material target has been used to study the high-velocity erosion of metal surfaces. A variety of metal alloys were examined, covering a wide range of both physical and mechanical properties. Projectile/target pairs of 15 and 30° cone angle have been impacted at 1.12 km/sec. The differences observed in the level of plastic deformation present in the target sections are attributable to target strength, impedance, and melt temperature. These experiments have been analyzed using metallographic examination and numerical simulation to characterize the extent and mode of near-surface deformation. The experiments lend insight into the nature of metal surface impacts and the physical/mechanical parameters which control metal erosion.

45737 **(SAND—87-1030C) Microstructural evolution and response to double-loop reactivation testing of heat-treated pH 13-8 Mo martensitic stainless steel.** Cieslak, W.R.; Cieslak, M.J.; Hills, C.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-871027—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009058.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The double loop electrochemical potentiokinetic reactivation (DL-EPR) test was used to investigate the intergranular and interlath corrosion susceptibility of pH 13-8 Mo as a function of heat treatment. Degree of sensitization was measured to the ratio of the peak current on a reverse (reactivation) scan to that on the forward anodic scan. Corrosion morphology was characterized by SEM, and microstructure by AEM. PH 13-8 Mo in the as-received condition was not sensitized. Precipitation-strengthening to the H925 temper caused susceptibility to intergranular corrosion, and averaging at H1150 caused susceptibility to interlath corrosion. Corrosion susceptibility was most likely caused by a classic Cr-depletion mechanism. 4 refs., 3 figs. (CS)

45738 **(UCRL—95460) Synergism of electroplating and vacuum processes.** Dini, J.W. (Lawrence Livermore National Lab., CA (USA)). 16 Apr 1987. Contract W-7405-ENG-48. 13p. (CONF-8708114—1). NTIS, PC A02. File Number DE87013496.

From 1. International Society for the Advancement of Materials Process Engineers Metals and Metals Processing conference; Cherry Hill, NJ, USA (18 Aug 1987).

Synergism can be obtained by combining electrodeposition and vacuum processes. In a number of cases, better coatings and improved adhesion can be obtained when the two processes are combined. Also, for some applications, parts that could not be fabricated by either method by itself, can be produced when the two processes are combined. A number of these examples are discussed in this paper.

45739 **(UCRL—96446) Formation of metastable structures and amorphous phases in Pu-based systems using the triode sputtering technique.** Rizzo, H.F.; Echeverria, A.W.; Wien, W.L.; Massalski, T.B. (Lawrence Livermore National Lab., CA (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1987. Contract W-7405-ENG-48. 17p. (CONF-870893—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014250.

From 6. international conference on rapidly quenched metals; Montreal, Canada (3 Aug 1987).

The triode sputtering technique has been used to obtain metastable crystalline and amorphous phases in ten binary systems of Pu with Si, Al, V, Fe, Co, Pd, Ta, Re, Os, and Ir. The lattice parameters and near-neighbor distances evaluated with x-ray diffraction frequently show deviations from an assumed Vegard's Law which can be interpreted in relation to the changing electronic configuration and corresponding size of the Pu atom. When the Egami and Waseda criterion is applied to predict the possible range of the amorphous phase formation, in terms of the atomic volume of the component atoms, the observed range exceeds the predicted range in Pu-rich alloys because the atomic size of the Pu atoms changes on alloying. 15 refs., 5 figs., 1 tab.

45740 **Spectroscopic evidence for passivation of the La/sub 1.85/Sr/sub 0.15/CuO_4 surface with gold.** Meyer H.M. III; Wagener, T.J.; Hill, D.M.; Gao, Y.; Anderson, S.G.; Krahn, S.D.; Weaver, J.H.; Flandermeyer, B.; Capone D.W. II. (Department of Chemical Engineering and Material Science, University of Minnesota, Minneapolis, Minnesota 55455). *Applied Physics Letters;* **51**: No. 14, 1118-1120(5 Oct 1987).

High-resolution x-ray photoemission and inverse photoemission have been used to study the microscopic formation of Au overlayers on the high T/sub c/ superconductor La/sub 1.85/Sr/sub 0.15/CuO_4. Our results indicate that Au does not induce disruption or surface reaction, unlike the reactive transition metals. The electronic states of the superconductor are attenuated as the Au overlayer covers the surface. We conclude that Au is a promising material for metallization and for passivation.

45741 **Effect of point defects on the phonon thermal conductivity of bcc iron.** Williams, R.K.; Graves, R.S.; Weaver, F.J.; Yarbrough, D.W. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6092). *Journal of Applied Physics;* **62**: No. 7, 2778-2783(1 Oct 1987). Contract AC05-84OR21400.

The effects of low concentrations of seven different substitutional impurities on the phonon thermal conductivity of iron were determined at 300 K. Of the seven solutes, Ni caused the smallest reduction and W the greatest. The data were analyzed on the basis of Callaway's model, and the resulting impurity scattering was compared with theory. The data show that phonon scattering from the local strain field associated with point defects is smaller than predicted from theory, but not negligible. The results are consistent with theoretical formulas that show that mass difference and lattice-strain scattering can either reinforce or cancel.

45742 **Electron-phonon interaction effects in tantalum.** Al-Lehaibi, A.; Swihart, J.C.; Butler, W.H.; Pinski, F.J. (Department of Physics, Indiana University, Bloomington, Indiana 47405). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 8, 4103-4111(15 Sep 1987).

The results of calculations for a number of electron-phonon interaction effects for tantalum are presented. The calculations are based on Korringa-Kohn-Rostoker energy bands, Born—von Karman phonons, and the rigid-muffin-tin approximation for the electron-phonon matrix element. The calculated Eliashberg spectral function α^2F is compared with the earlier tunneling data of Shen and the proximity tunneling data of Wolf et al. The calculated and tunneling transverse-phonon peaks agree well, but the height of the tunneling longitudinal-phonon peak is smaller than the calculated results. The calculated electron-phonon coupling parameter λ is 0.88, which is larger than the λ determined from superconducting tunneling and superconducting T/sub c/ measurements, but is slightly smaller than the λ determined from electronic specific-heat measurements. Calculated phonon linewidths along various symmetry directions are presented. The temperature dependence of the electrical resistivity due to phonon scattering is calculated in the lowest-order variational approximation and it agrees with experiment. The point-contact spectral function of Kulik, $G(\omega)$, is determined and compared with $\alpha^2F(\omega)$. The agreement between calculated and measured electronic specific heat and high-temperature electrical resistivity gives strong support to the validity of the rigid-muffin-tin approximation for electron-phonon matrix elements.

45743 **Solid-solution strengthening: Substitution of V in Ni_3Al and structural stability of Ni_3(Al,V).** Xu, J.; Oguchi, T.; Freeman, A.J. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 8, 4186-4189(15 Sep 1987).

Several questions relating to solid-solution strengthening in Ni_3Al: substitution of V and its effect on the stability of the $L1_2$ structure of Ni_3Al: are addressed using an all-electron total-energy local-density approach. By comparing the total energies of two ($L1_2$-like and D0/sub 22/-like) different structures of Ni_3(Al/sub 0.5/,V/sub 0.5/), greater stability of the $L1_2$ structure for ternary additions of V compared with the D0/sub 22/-like structure is found (i.e., for V substitution on Al rather than Ni sites).

45744 **Quantitative "local-interference" model for 1/f noise in metal films.** Pelz, J.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 8, 4479-4482(15 Sep 1987).

Electron scattering calculations by Martin are used to predict the magnitude of resistivity fluctuations in metal films arising from the fluctuating interference of electrons in the local environment of a moving defect. A "local-interference" model based on these calculations accounts for the 1/f-noise magnitude observed in irradiated Cu films and in room-temperature metal films. For relatively ordered metal films at room temperature this model predicts larger noise magnitudes than an alternative model based on universal conductance fluctuations, while the latter model predicts larger noise in metals that are sufficiently disordered and/or at lower temperatures.

45745 **Extended x-ray-absorption fine-structure study of amorphous (Ni/sub x/Pt/sub 100-//sub x/)/sub 75/P/sub 25/ alloys.** Choi, M.; Budnick, J.I.; Hayes, G.H.; Pease, D.M.; Heald, S.M.; Sayers, D.E.; Hasegawa, R. (Department of Physics and Institute of Materials Science, University of Connecticut, Storrs, Connecticut 06268). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 9, 4613-4623(15 Sep 1987).

The Pt L_3 edge and the Ni K edge extended x-ray-absorption fine-structure (EXAFS) measurements have been made on amorphous (Ni/sub x/Pt/sub 100-//sub x/)/sub 75/P/sub 25/ alloys at three low temperatures as well as at room temperature. With a limited k range, the Fourier transforms of the Pt L_3 and the Ni K EXAFS for amorphous Ni-Pt-P alloys exhibit extremely broad peaks which manifest an unusually large disorder of the system. As the maximum k range of the transformation is extended with an enhanced signal-to-noise ratio, these broad major peaks in the Fourier transforms still remain broad and begin to split into two and finally into three. The relative magnitudes and the thermal variation of these three split peaks strongly indicate the existence of subshells for different atomic pairs such as Pt-P, Pt-Ni, and Pt-Pt. Though it is not possible, at present, to determine the degree of asymmetry in the radial distribution of each subshell, a rough simulation of the split peaks in the Fourier transforms of the Pt L_3 EXAFS data at 7 K for two compositions of amorphous Ni-Pt-P provides further evidence for the existence of separate subshells for different atomic pairs. Moreover, while the thermal disorder is apparently greater for a Pt-Pt pair subshell than those of the two other subshells, the structural disorder seems to be greater for a Pt-Ni pair subshell than that for a Pt-Pt subshell.

45746 **Dynamics of twin boundaries in martensites.** Barsch, G.R.; Horovitz, B.; Krumhansl, J.A. (Materials Research Laboratory and Department of Physics, Pennsylvania State University, University Park, Pennsylvania 16802). *Physical Review Letters;* **59**: No. 11, 1251-1254(14 Sep 1987). Contract FG02-85ER45214.

The theory of forming a coherent twinning array in a parent phase is studied for a tetragonal to orthorhombic displacive transition. We find that this structure can be stabilized without the use of dislocations by a long-range interaction between the twin boundaries which is mediated via the parent phase. The dynamics of the twin boundary lattice consists of elementary excitations with sur-

prisingly low frequency and a limiting — (wave vector)/sup 1/2/ dispersion.

45747 **Electronic properties of the half-metallic ferromagnetic NiUSn.** Albers, R.C.; Boring, A.M.; Daalderop, G.H.O.; Mueller, F.M. (Center for Materials Science and Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 3661-3664(1 Sep 1987).

The electronic structure of NiUSn was obtained using a spin-polarized scalar relativistic linear muffin-tin orbital (LMTO) method. The self-consistent calculations were performed at the observed experimental lattice constant for the cubic MgAgAs crystal structure. Because of the open nature of this crystal structure the LMTO combined correction terms as well as additional empty spheres were used. Like transition-metal analogs (NiMnSb, for example) NiUSn is found to be a half-metallic magnet, with a semiconducting gap in the minority-spin bands and metallic behavior for the majority-spin bands. The calculated magnetic moment (1.99μ/sub B/) was found to be about (2/3 of the experimental high-temperature value (3.08μ/sub B/).

45748 **Relationships between local order and magnetic behavior in amorphous Fe/sub 0.30/Y/sub 0.70/: Extended x-ray-absorption fine structure and susceptibility.** Morrison, T.I.; Foiles, C.L.; Pease, D.M.; Zaluzec, N.J. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 3739-3744(1 Sep 1987). Contract AS05-80ER10742.

X-ray-absorption near-edge-structure spectroscopy, extended x-ray-absorption fine-structure spectroscopy, electron energy-loss spectroscopy, and susceptibility measurements have been used to study the relationships between local order, d-band occupancy, and magnetic properties in amorphous Fe/sub 0.30/Y/sub 0.70/. All the results can be interpreted as being due to the existence of amorphous iron clusters in an amorphous yttrium matrix. The relations between structure and magnetic properties in amorphous binary alloys are discussed.

45749 **Local-density prediction of the Fermi surface of UBe/sub 13/.** Norman, M.R.; Pickett, W.E.; Krakauer, H.; Wang, C.S. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 4058-4061(1 Sep 1987).

The linearized augmented-plane-wave method has been applied to calculate the Fermi surface (FS) of UBe/sub 13/. In spite of having 14 f bands within about 1 eV of the Fermi level, the calculated FS is surprisingly simple. The X-centered pieces have band masses m/sub b/ = 3m—4m, while the two Γ-centered orbits have masses of the order of m and 3m. Comparison of the band density of states with the specific-heat density of states suggests some of the bands have effective masses of 300m—400m.

45750 **Ce(Cu/sub 0.9/Ag/sub 0.1/)$_6$: Highest electronic specific-heat coefficient of the heavy-fermion systems.** Gangopadhyay, A.K.; Schilling, J.S.; Yang, H.D.; Shelton, R.N. (Sektion Physik, University of Munich, Schellingstrasse 4, D-8000 Munich 40, West Germany). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 4086-4089(1 Sep 1987).

We have measured the static magnetic susceptibility chi of the compound Ce(Cu/sub 1-//sub x/Ag/sub x/)$_6$ for $x \leqq 0.1$ from 2.4 to 300 K and the specific heat of one sample ($x = 0.1$) from 0.6 to 30 K. The effect of Ag substitution is to markedly increase both chi and the Sommerfeld constant γ at low temperatures. γ for the $x = 0.1$ sample is temperature dependent and reaches the value 2.1 J/mole K^2 at 0.6 K, extrapolating to approximately 2.8 J/mole K^2 at $T = 0$ K. These results can be analyzed in terms of a twofold decrease in the value of the Kondo temperature T/sub K/ with 10% Ag substitution.

45751 **Neutron irradiation scoping study of twenty-five copper-base materials.** Harling, O.K.; Grant, N.J.; Kohse, G.; Ames, M.; Lee, T.; Hobbs, L.W. (Nuclear Reactor Laboratory and Department of Materials Science and Engineering, Massachusetts Institute of Technology, 138 Albany Street, Cambridge, Massachusetts 02139). *Journal of Materials Research;* **2**: No. 5, 568-579(Sep 1987).

A scoping irradiation test was carried out to help define the performance of copper-base materials in potential fusion applications. Twenty-five different copper materials including oxide dispersion-stabilized and precipitation-hardened powder metallurgy alloys, as well as pure copper and solid solution-strengthened ingot alloys, were neutron irradiated to 13.5 dpa at 400 °C in the Experimental Breeder Reactor II (EBR-II) fast reactor. Volumetric swelling and electrical conductivity data were measured for all irradiated materials, and four selected materials were characterized for mechanical property changes using miniaturized disk bend test. A number of these copper alloys, especially those prepared by powder metallurgy techniques, showed low swelling (less than 0.3%), small changes in conductivity (less than +- 5%), and relatively small changes in yield strength with good post-irradiation ductility. Preliminary electron microscopy results show microstructural changes that are consistent with the results of the macroscopic studies. The pure copper materials showed significant changes in conductivity and high levels of swelling as a result of the neutron exposure. It is apparent that a variety of copper alloys can survive fast neutron exposures to at least 13.5 dpa at 400 °C without unacceptable changes in density, conductivity, or yield strength. Further irradiation testing to much higher doses and experimental investigation of the effect of transmutation product gases are needed to fully define the response of available copper alloys to fusion reactor environments.

45752 **Kinetics of phase separation in Mn/sub 0.67/Cu/sub 0.33/.** Gaulin, B.D.; Spooner, S.; Morii, Y. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **59**: No. 6, 668-671(10 Aug 1987). Contract AC05-84OR21400.

We have examined the kinetics of phase separation in Mn/sub 0.67/Cu/sub 0.33/ using time-resolved neutron-scattering techniques. In an early-time regime, the kinetics follows the Cahn-Hilliard-Cook linear theory of spinodal decomposition. There is an intermediate stage. Then, at a late time, dynamic scaling is obeyed. The time dependence of the wave vector at maximum scattering intensity (which is inversely proportional to the average linear domain size) can be well described over the entire late-time regime and much of the intermediate-time regime by arguments recently put forward for earlier-time corrections to the limitingly late-time stages of phase separation.

45753 **Positron-annihilation study of the electronic structure of Cu/sub 91/Ge$_9$.** Mijnarends, P.E.; Rabou, L.P.L.M.; Hanssen, K.E.H.M.; Bansil, A. (Netherlands Energy Research Foundation ECN, 1755 ZG Petten, The Netherlands). *Physical Review Letters;* **59**: No. 6, 720-723(10 Aug 1987).

A novel effect of alloying on the electron momentum density in a disordered α-Cu/sub 91/Ge$_9$ alloy is reported. The effect, which is the appearance of a bump in the derivative spectra at low momenta, is predicted by theory employing the coherent-potential approximation and is observed in two-dimensional angular correlation experiments on the alloy. It reflects the presence of an s-p impurity band far below the Fermi level. Accurate experimental values for the Fermi-surface radii k/sub 100/ and k/sub 110/ and for the associated disorder-induced smearings in CuGe are also reported for the first time.

45754 **Horizontal electromagnetic casting of thin metal sheets.** Hull, J.R.; Lari, R.J.; Praeg, W.F.; Turner, L.R. (to Dept. of Energy, Washington, DC). US Patent 4,678,024. 7 Jul 1987. Filed date 10 Jun 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an apparatus for the horizontal casting of thin metals sheets comprising: vessel means containing a molten metal and including an aperture for discharging the molten metal in

the form of a thin, horizontal sheet; electromagnetic conducting means positioned adjacent to the aperture in the vessel means and in spaced relation from the molten metal sheet for directing a horizontal magnetic field across and about the molten metal sheet; and conductive shield means positioned within the magnetic field and electrically coupled to the molten metal sheet for defining a horizontally oriented equilibrium position of the molten metal sheet. Within the magnetic field, the strength of the magnetic field increases with increasing displacement of the molten metal sheet below the equilibrium position and decreases with increasing displacement of the molten metal sheet above the equilibrium position. The magnetic field exerts a constant, uniform levitation force on the molten metal sheet.

45755 **Third stage of irradiation creep involving its cessation at high neutron exposures.** Garner, F.A.; Makenas, B.J.; Porter, D.L. (Hanford Engineering Development Lab., Richland, WA, USA; Argonne National Lab., IL, USA. EBR-II Project). *Journal of Nuclear Materials;* **148**: No. 3, 279-287(May 1987). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

As swelling approaches 5-10% in AISI 316, the creep rate appears to rapidly decline and eventually vanish. There may be some correlation between this phenomenon and concurrent changes in failure mode that also appear to be related to void swelling. For some fusion-relevant applications, creep correlations derived from fast reactor data may lead to an overprediction of the creep strain.

45756 **Possible influence of order-disorder transformations on the swelling of 85Ni-15Cr nichrome alloy.** Garner, F.A. (Hanford Engineering Development Lab., Richland, WA, USA). *Journal of Nuclear Materials;* **148**: No. 3, 288-293(May 1987). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The binary alloy 85Ni-15Cr swells during neutron irradiation in a manner that is quite unrepresentative of either simple austenitic alloys of pure nickel. The nickel-chromium system is known to exhibit ordering out of reactor and this alloy was used to test the concept that alloys which develop order exhibit lower swelling rates. When the neutron irradiation data are compared to that of ion irradiations conducted by Hudson and Ashby on Ni-Cr alloys, it is shown that chromium additions appear to depress swelling in nickel initially but also appear to suppress the tendency for swelling to saturate at high exposure. Below a transition temperature near 550/ sup 0/C the swelling is relatively sluggish and is quite insensitive to irradiation temperature. Above the transition temperature the swelling behavior is more complex but typical of austenitic alloys. The swelling transition temperature is thought to be related to the critical temperature for order-disorder transformation.

45757 **Neutron irradiation of Fe-Mn, Fe-Cr-Mn and Fe-Cr-Ni alloys and an explanation of their differences in swelling behavior.** Garner, F.A.; Brager, H.R.; Gelles, D.S.; McCarthy, J.M. (Hanford Engineering Development Lab., Richland, WA, USA). *Journal of Nuclear Materials;* **148**: No. 3, 294-301(May 1987). (CONF-860421—).

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The swelling and phase stability of neutron-irradiated Fe-Cr-Mn and Fe-Cr-Ni alloys are compared in the range 420-600/sup 0/C. While the behavior of the two alloy systems exhibits many similarities, that of the Fe-Cr-Mn system is more complex, involving a higher level of phase instabilities. However, the sensitivity of radiation-induced density changes to composition is less in the Fe-Cr-Mn system. In the Fe-Cr-Mn system there are three major components of density change, namely void growth, ferrite formation and lattice parameter changes of the retained austenite; whereas void swelling is the only major component of density change in the Fe-Cr-Ni system.

45758 **Electronic structure, magnetic moment, charge density, and spin density in $Nd_2Fe_{14}B$.** Gu, Z.; Ching, W.Y. (Univ. of Missouri, Kansas City). *Applied Physics Communications;* **7**: No. 1-2, 114-115(Mar-Jun 1987). Contract FG02-84ER45170.

The electronic structure of the complex intermetallic compound, $Nd_2Fe_{14}B$ has been calculated using the first principles of orthogonalized linear combination of atomic orbitals method. The f electrons in Nd are included in the determination of Fermi energy. Results are presented for the total density of states (DOS), orbital-decomposed, site-decomposed, and spin-decomposed partial DOS. The calculated spin-magnetic moments on each of the six inequivalent sites in the iron sublattice are in good agreement with the values deduced from polarized neutron scattering experiments. The charge density map and the spin density map on the basal plane of the tetragonal cell show evidence of covalent bonding between Fe and B atoms and reveal the distortion from the spherically symmetric distribution around the atomic sites.

45759 **Texture in ZIRCALOY-clad uranium.** Ross, F.; Reichel, D.; Krawitz, A.; Mueller, M.; Richardson, J. (Argonne National Lab., IL). *Applied Physics Communications;* **7**: No. 1-2, 120-121(Mar-Jun 1987).

An enriched (30% ^{235}U) uranium target is being fabricated for the ANL spallation neutron source (IPNS). They have measured the orientation distribution of neutron diffraction intensities (texture) of test casting made of depleted ^{238}U. Their results indicate the presence of large grains which may swell anisotropically with radiation damage and produce a separation of the ZIRCALOY protective cladding from the surface of the metal. Similar studies of material subjected to β-heat treating (quenching from the tetragonal β-phase into the orthorhombic α-phase, T/sub $\beta \rightarrow \alpha$/ = 662°C) shows a mild texture. The rapid formation of orthorhombic grains within the larger tetragonal ones produces an acceptable small grain size and reduced orientation. Unfortunately, diffusion bonding of the ZIRCALOY cladding requires slow-cooling from the γ-phase (T/sub $\gamma \rightarrow \beta$/ = 772°C) and they have established that this procedure causes dramatic grain regrowth. Studies are underway to determine if the diffusion bond between the ZIRCALOY cladding and the uranium metal is weakened by the β-heat treating process. They will discuss the measurement of grain size and orientation (texture), the nature of the $\beta \rightarrow \alpha$ phase transition and the problems of grain regrowth.

45760 **Erosion research on the U.S. Department of Energy Fossil Energy Materials Program.** Judkins, R.R.; Bradley, R.A. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-146.

Research projects on the U.S. Department of Energy Fossil Energy Materials Program are investigating the mechanisms of erosion and erosion-corrosion of alloys and cermets used in fossil energy systems. The aim is to obtain an understanding of erosion mechanisms that will provide the basis for the development or modification of alloys and cermets with improved erosion resistance. Projects on this program are outlined. Results of recent research activities are presented, and plans for future research are described.

45761 **A study of the galling of two steels using two test methods.** Swanson, P.A.; Ives, L.K.; Whitenton, E.P.; Peterson, M.B. (Deere and Co. Technical Center, Moline, IL). pp 49-58 of Wear of materials - 1987. Ludema, K.C. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870476—).

From International conference on wear of materials; Houston, TX, USA (5 Apr 1987).

In this study the galling behavior of two heat treated steels, AISI 1541 and 8620, was investigated. Two laboratory tests were used. The first utilized a sphere-on-flat contact geometry and the second a flat-on-flat geometry. The galling damage that was generated was measured by using a stylus profilometer to collect a series of parallel profiles through the damage zone. The maximum peak-to-valley distance for each profile was calculated and the average of this parameter was then used to quantify the amount of galling that was produced. This measurement technique enabled the authors to not only assess the galling behavior of the test materials

but it also allowed us to determine the variability inherent in each test method. Significantly less damage was obtained for carburized 8620 on "as-quenched" 1541 steel than was observed when the quenched 1541 steel was tested under self-mated conditions. The greatest amount of damage was generated when hot-rolled 1541 steel was run against itself. Possible reasons for these results are reviewed.

45762 **The influence of stacking fault energy and adhesion on the wear of Cu and Al - bronze.** Wert, J.J.; Sloan, G.A.; Cook, W.M. (Vanderbilt Univ., Nashville, TN). pp 81-92 of Wear of materials - 1987. Ludema, K.C. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870476—).

From International conference on wear of materials; Houston, TX, USA (5 Apr 1987).

The subsurface deformation induced in pure Cu and a series of Cu-Al alloys is characterized using scanning electron microscopy after prolonged, dry sliding contact against in Al/sub 2/O/sub 3/ cylinder. Scanning electron microscopy was found to be a very useful technique for examining the deformation in depth. The strength of the adhesive bond between Cu and Al/sub 03/ was found to be less than the cohesive strength of either materials. Therefore true transfer layers were not formed. Two mechanisms were identified for the production of wear debris. The layered structure explains the random misorientation of subgrains. The adhesive strength of the Cu-Al alloys examined to Al/sub 2/O/sub 3/ was greater than the cohesive strengths of the alloys. Therefore metal transfer to the slider occurred. The subsurface deformation behavior of Al-bronze was found to be very dependent on both the stacking fault energy (SFE) and orientation of individual grains and is related to the wear rate. In the case of Al-bronze sliding against Al/sub 2/O/sub 3/, adhesion effects overshadow the influence of SFE.

45763 **The erosion of carbide-metal composites.** Ninham, A.J.; Levy, A.V. (Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 825-832 of Wear of materials - 1987. Ludema, K.C. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870476—). Contract AC03-76SF00098.

From International conference on wear of materials; Houston, TX, USA (5 Apr 1987).

A number of alloys composed of carbide particles in a ductile metal matrix are eroded to elucidate the role of carbides during erosion. The alloys covered two ranges of carbide volume fraction; less than 30 vol.% (spheroidized plain carbon steels and cast high carbon alloys), and greater than 60 vol.% (cermets). All specimens were eroded by quartz abrasive at a range of impact angles and at 60ms/sup -1/ in a gas-blast type rig. In addition to mass loss data and examination of eroded surfaces to characterize the erosion behavior, specimens were taper sectioned and then examined by scanning electron microscopy. This technique allows simultaneous observation of an eroded surface and the underlying microstructure, facilitating the determination of erosion mechanisms. The high carbide content cermets exhibited increasing erosion resistance as the carbide volume fraction was increased. For these alloys the carbide content is so high that the carbides are in contact and support each other, with a diminishing reliance on the softer matrix for support. At carbide fractions of about 70 vol.% some cermets eroded at rates comparable to those of plain carbon steels. Carbide fractions of about 90 vol.% were needed in most cases to effect a significant improvement in erosion resistance.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 45593, 45697, 45697, 45703, 45713, 45734, 45759, 45760, 45847, 45855, 45913, 45932, 46040, 46405, 46726, 46789, 46807

45764 **(AD-A—181269/2/XAB) Determination of the low-work-function planes of LaB_6.** Gesley, M.; Swanson, L.W. (Oregon Graduate Center, Beaverton (USA)). 1984. 18p. NTIS, PC A02/MF A01.

Pub. in Surface Science, Vol. 146, 583-599(1984).

A study of the temperature and orientation dependence of the field ion and electron emission and the average work function for a LaB_6 emitter have been carried out between 77 and 1800 K. These results indicate that the (310) surface is thermally stable and has the lowest work function of any single crystal plane of LaB_6. This result is confirmed by field-emission retarding-potential (FERP) work-function (phi) measurements at 300 K which gives phi (310) = 2.50eV. The results show the relative orientation dependence of the room-temperature work function (phi) measurements at 300 K which gives phi (310) < phi (210) < phi (100) < phi (110) < phi (111) < phi (211). This ordering is in accordance with the relative dipole contribution to the work function when surface reconstruction is included. The orientation dependence of the field electron emission is sensitive to field evaporation, thermal equilibration, and carbon contamination.

45765 **(AD-A—181410/2/XAB) Fabrication and characterization of rare earth hexaboride single-crystal materials.** Davis, P.R.; Swanson, L.W.; Hutta, J.J.; Jones, D.L. (Oregon Graduate Center, Beaverton (USA). Dept. of Applied Physics and Electronic Science). 1986. 15p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Materials Science, Vol. 21, 825-836(1986).

Oriented single crystals of LaB_6, CeB_6 and PrB_6 were prepared by the arc float-zone refining technique, which is described. A critique of the various possible preparation techniques is given. Wet chemical methods were used to determine bulk stoichiometries of samples prepared from starting materials of various R/B compositions (where R = rare earth). It was found that LaB6.09, a desired composition, could be grown in single-crystal form from LaB6.2 starting material, the excess boron compensating for preferential boron vaporization. Starting materials with B/La < 6.2 produce a B/La gradient in two-pass zone-refined specimens. The level of metallic impurities in arc zone-refined LaB_6 is lower than that reported elsewhere for laser zone-refined LaB_6. Residual oxygen present in the zone-refined specimens was found to produce second-phase inclusions, which were studied in detail. The effect of contamination of LaB_6 surfaces by evaporated refractory metals was also investigated.

45766 **(BMFT-FB-T—86-171) Production of α-wollastonite and its application in ceramics for reducing energy consumption. Final report.** Kienow, E. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Rheinische Kalksteinwerke G.m.b.H., Wuelfrath (Germany, F.R.)). Dec 1986. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87770253.

Natural wollastonite is an efficient raw material for ceramics. It should be tried to produce a cheap synthetic wollastonite as raw material. It was aimed to save energy by using wollastonite in ceramics even on account of the amount of energy for producing wollastonite. A cement kiln was prepared for production of synthetic wollastonite. Different raw materials were used for sintering wollastonite and diopside. The synthetic wollastonite was tested in stoneware and earthenware. The tests were succesful. Now the synthetic wollastonite is a raw material for a earthenware tile production. It is obvious, that wollastonite and diopside as flux could decrease energy consumption. With 21 refs., 17 tabs., 37 figs.

45767 (INIS-SU—423, pp 104-105) **Partial thermodynamic properties of Bi_2O_3 in solid solutions Bi_2O_3-Ta_2O_5.** Berezovskaya, Yu.M.; Vasil'eva, I.A.; Majorova, A.F. (Moskovskij Gosudarstvennyj Univ., USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45768 (INIS-SU—423, pp 64-65) **New approach in calculations of thermodynamic functions of refractory borides.** Goryachev, Yu.M.; Kovenskaya, B.A.; Shvartsman, E.I. (Institute Problem Materialovedeniya, Kiev, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45769 (INIS-SU—423, pp 110-111) **Thermodynamic properties of Ln-Cu-O (Ln = La, Pr, Nd, Sm, Eu) systems.** Zuev, A.Yu.; Petrov, A.N.; Cherepanov, V.A. (Ural'skij Gosudarstvennyj Univ., Sverdlovsk, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45770 **(N—87-24573) Processing of laser formed SiC powder. Final report.** Haggerty, J.S.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1987. 80p. (NASA-CR—179638; NAS—1.26:179638). NTIS, PC A05/MF A01.

Processing research was undertaken to demonstrate that superior SiC characteristics could be achieved through the use of ideal constituent powders and careful post-synthesis processing steps. Initial research developed the means to produce approximately 1000 A uniform diameter, nonagglomerated, spherical, high purity SiC powders. Accomplishing this goal required major revision of the particle formation and growth model from one based on classical nucleation and growth to one based on collision and coalescence of Si particles followed by their carburization. Dispersions based on pure organic solvents as well as steric stabilization were investigated. Test parts were made by the colloidal pressing technique; both liquid filtration and consolidation (rearrangement) stages were modeled. Green densities corresponding to a random close packed structure were achieved. After drying, parts were densified at temperatures ranging from 1800 to 2100 C. This research program accomplished all of its major objectives. Superior microstructures and properties were attained by using powders having ideal characteristics and special post-synthesis processing procedures.

45771 **(N—87-25004) Analysis of boron carbides' electronic structure. Final technical report, 18 July 1984-17 August 1986.** Howard, I.A.; Beckel, C.L. (New Mexico Univ., Albuquerque (USA)). Aug 1986. 29p. (NASA-CR—181082; JPL—9950-1312; NAS—1.26:181082; RE—156). NTIS, PC A03/MF A01.

The electronic properties of boron-rich icosahedral clusters were studied as a means of understanding the electronic structure of the icosahedral borides such as boron carbide. A lower bound was estimated on bipolaron formation energies in B_{12} and $B_{11}C$ icosahedra, and the associated distortions. While the magnitude of the distortion associated with bipolaron formation is similar in both cases, the calculated formation energies differ greatly, formation being much more favorable on B11C icosahedra. The stable positions of a divalent atom relative to an icosahedral borane was also investigated, with the result that a stable energy minimum was found when the atom is at the center of the borane, internal to the B_{12} cage. If incorporation of dopant atoms into B_{12} cages in icosahedral boride solids is feasible, novel materials might result. In addition, the normal modes of a $B_{12}H_{12}$ cluster, of the C_2B_{10} cage in para-carborane, and of a B_{12} icosahedron of reduced (D sub 3d) symmetry, such as is found in the icosahedral borides, were calculated. The nature of these vibrational modes will be important in determining, for instance, the character of the electron-lattice coupling in the borides, and in analyzing the lattice contribution to the thermal conductivity.

45772 **Experiments concerning the connective nature of superconductivity in $YBa_2Cu_3O_7$.** Larbalestier, D.C.; Daeumling, M.; Cai, X.; Seuntjens, J.; McKinnell, J.; Hampshire, D.; Lee, P.; Meingast, C.; Willis, T.; Muller, H.; and others. (University of Wisconsin, 1500 Johnson Drive, Madison, Wisconsin 53706). *Journal of Applied Physics;* **62**: No. 8, 3308-3313(15 Oct 1987).

Samples of $YBa_2Cu_3O_7$ have been prepared with rather sharp inductive transitions having in the best cases breadths of 7 K and midpoint T/sub c/ values of 88 K. The resistive T/sub c/ midpoints are 92—95 K with transition widths of +- 1—2 K. Flux shielding at 4.2 K is normally 100% and flux expulsion at 4.2 K reaches 95%. However, even small fields of order 1 mT decouple some 15%—20% of the volume, allowing flux to enter the samples. Resistive Hc_2 measurements suggest that $Hc_2(0)$ varies from <1 to >300 T, depending on the criterion chosen. ac susceptibility measurements suggest that $Hc_2(0)$ is —60 T. Magnetization current densities are relatively high (150—200 A/mm² at 1—10 T at 4.2 K) but measured transport current densities are small (≦1 A/mm²). Magnetization current densities at 77 K are about two orders of magnitude lower. The samples were seen to be heavily twinned by light microscopy (scale of 1—5 μm) and by transmission electron microscopy (scale of —250 nm). It is concluded that these measurements are consistent with a model of superconducting regions of reduced dimensionality coupled by tunneling.

45773 **Reaction and intermixing at metal-superconductor interfaces: Fe/YBa_2Cu_3O/sub 6.9/.** Gao, Y.; Wagener, T.J.; Weaver, J.H.; Flandermeyer, B.; Capone D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Applied Physics Letters;* **51**: No. 13, 1032-1034(28 Sep 1987).

Inverse photoemission studies of the interface formed when Fe is deposited onto the high-temperature superconductor YBa_2Cu_3O/sub 6.9/ show that Fe leaches oxygen from the near surface region to nucleate an insulating form of Fe-O. Ultimately, a metallic Fe layer grows but it has surface segregated Ba, even after 250 A of coverage. These results demonstrate that reactive metal overlayers drastically alter the chemical and physical properties of the superconductor.

45774 **Microstructure and properties of YBa_2Cu_3O/sub 9-//sub δ/ superconductors with transitions at 90 and near 290 K.** Narayan, J.; Shukla, V.N.; Lukasiewicz, S.J.; Biunno, N.; Singh, R.; Schreiner, A.F.; Pennycook, S.J. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695). *Applied Physics Letters;* **51**: No. 12, 940-942(21 Sep 1987).

We have investigated the microstructure and properties of YBa_2Cu_3O/sub 9-//sub δ/ that contain resistive transitions at 90 and near 290 K using high-resolution and analytical transmission electron microscopy and Raman scattering techniques. The specimens contain normal orthorhombic (Pmmm space group) phase associated with T/sub c/ = 90 K, and another phase which we tentatively assign it to be associated with the resistive transitions near 290 K. The new phase has a c axis larger by about 16% and it grows epitaxially on the {100} planes of the orthorhombic (tripled perovskite unit cell) phase having T/sub c/ = 90 K.

45775 **Observation of an oxygen isotope effect in $YBa_2Cu_3O_7$.** Leary, K.J.; zur Loye, H.; Keller, S.W.; Faltens, T.A.; Ham, W.K.; Michaels, J.N.; Stacy, A.M. (College of Chemistry, University of California, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 11, 1236-1239(14 Sep 1987).

A small decrease in T/sub c/ of 0.3 K to 0.5 K is observed when as much as 90% of the /sup 16/O in $YBa_2Cu_3O_7$ is substituted with /sup 18/O. This result is consistent with our observation that there is an oxygen isotope effect in La/sub 1.85/Sr/sub 0.15/CuO_4, but in contrast with previous reports that there is no isotope effect for $YBa_2Cu_3O_7$. This new result suggests that phonons play an important role in the electron-pairing mechanism in $YBa_2Cu_3O_7$.

45776 **Oxygen ordering and the orthorhombic-to-tetragonal phase transition in YBa_2Cu_3O/sub 7-//sub x/.** Jorgensen, J.D.; Beno, M.A.; Hinks, D.G.; Soderholm, L.; Volin, K.J.; Hitterman, R.L.; Grace, J.D.; Schuller, I.K.; Segre, C.U.; Zhang, K. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3608-3616(1 Sep 1987).

In situ neutron powder diffraction measurements show that the orthorhombic-to-tetragonal phase transition in YBa_2Cu_3O/sub 7-//sub x/ which occurs near 700 °C in a pure oxygen atmosphere, is an order-disorder transition in which the disordering of oxygen atoms into a normally vacant site destroys the one-dimensional Cu-O chains present in the room-temperature orthorhombic structure. For both structures, the oxygen stoichiometry decreases monotonically with increasing temperature. The transition temperature depends on the oxygen partial pressure and occurs when the stoichiometry is near YBa_2Cu_3O/sub 6.5/. The tetragonal structure has a

partially occupied, nearly octahedral Cu-O arrangement, in contrast to the orthorhombic structure which has one-dimensional Cu-O chains. The observed depression of the superconducting transition temperature in tetragonal $YBa_2Cu_3O_{7-x}$, which has been quenched from high temperature, could result either from the disordering of oxygen atoms which destroys the one-dimensional chains or from the absence of Cu/sup 3+/ ions.

45777 **Unoccupied electronic states and surface phenomena for $YBa_2Cu_3O_{6.9}$.** Wagener, T.J.; Gao, Y.; Weaver, J.H.; Arko, A.J.; Flandermeyer, B.; Capone, D.W. II. (Department of Chemical Engineering and Materials Science, University of Minneosta, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3899-3902(1 Sep 1987).

Inverse photoemission was used to probe the unoccupied electronic levels within 25 eV of E/sub F/ for the high-temperature superconductor $YBa_2Cu_3O_{6.9}$. Our results show that the density of states is low from E/sub F/ to —3.7 eV above E/sub F/ . Large emission features appearing at 6.6 and 8.6 eV are associated with Ba 5d- and Y 4d-derived bands, respectively, while structure at 13.4 eV above E/sub F/ is due to localized Ba 4f states. Energy-dependent studies reveal a dispersive band between —4 and —6 eV above E/sub F/. An oxygen-induced feature was observed at 1.8 eV, but there is no evidence that high-energy electron-stimulated desorption removes these chemisorption states.

45778 **Oxygen-vacancy behavior in La/sub 2-//sub x/Sr/sub x/CuO/sub 4-//sub y/ by positron annihilation and oxygen diffusion.** Smedskjaer, L.C.; Routbort, J.L.; Flandermeyer, B.K.; Rothman, S.J.; Legnini, D.G.; Baker, J.E. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3903-3905(1 Sep 1987). Contract W-31-109-ENG-38.

Oxygen-diffusion and positron-annihilation results for La/sub 2-//sub x/Sr/sub x/CuO/sub 4-//sub y/ compounds are reported. A qualitative explanation of the observed results is given on the basis of a model in which the oxygen-vacancy concentration in La/sub 2-//sub x/Sr/sub x/CuO/sub 4-//sub y/ is determined by Sr/sup 2+/ ion clustering on the La sublattice. This model also leads to a maximum in the Cu/sup 3+/ ion concentration as a function of the Sr/sup 2+/ ion concentration.

45779 **Normal-state properties of $ABa_2Cu_3O_{7-y}$ compounds (A = Y and Gd): Electron-electron correlations.** Cheong, S.; Brown, S.E.; Fisk, Z.; Kwok, R.S.; Thompson, J.D.; Zirngiebl, E.; Gruner, G.; Peterson, D.E.; Wells, G.L.; Schwarz, R.B. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3913-3916(1 Sep 1987).

Resistivity, thermoelectric power, Hall effect and magnetic susceptibility measurements are reported in the normal state of the high-T/sub c/ compounds $YBa_2Cu_3O_{7-y}$ and $GdBa_2Cu_3O_{7-y}$. The results are different from those expected for an uncorrelated metallic band. We suggest that Coulomb interactions are important and that the interaction energy is comparable to or larger than the uncorrelated bandwidth, leading to moderately heavy-fermion-like behavior in the normal state. The Sommerfeld coefficient γ calculated from the susceptibility indicates that the electron-phonon coupling constant at T/sub c/ is not unusually large.

45780 **Inverse photoemission studies of the empty electronic states and surface stability of La/sub 1.85/Sr/sub 0.15/CuO_4.** Gao, Y.; Wagener, T.J.; Weaver, J.H.; Arko, A.J.; Flandermeyer, B.; Capone, D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3971-3974(1 Sep 1987).

The energy distribution of the unoccupied electronic states of the high-T/sub c/ superconductor La/sub 1.85/Sr/sub 0.15/CuO_4 have been identified at room temperature using inverse photoemission. The density of states is very low from E/sub F/ to —3.5 eV above E/sub F/, strong emission features appear 5.8 and 8.7 eV above the Fermi level, E/sub F/, and the empty-state spectrum is unstructured thereafter until at least 25 eV. The prominent empty-state features are confined to an energy interval of —8 eV and are associated with the La 5d and 4f levels. The ratio of 4f intensity to 5d intensity showed a —5 fold increase for incident electron energies of —1500 eV compared to —30 eV. Our empty-state studies showed that the effects of high-energy electron-stimulated desorption were most pronounced —1.6 eV above E/sub F/, and the exposure of the sample to oxygen showed enhancement of these states.

45781 **Oxygen withdrawal, copper valency, and interface reaction for Fe/La/sub 1.85/Sr/sub 0.15/CuO_4.** Hill, D.M.; Meyer, H.M. III; Weaver, J.H.; Flandermeyer, B.; Capone, D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3979-3982(1 Sep 1987).

High-resolution x-ray photoemission spectroscopy was used to study reactive interface formation for Fe adatoms deposited onto the high-temperature superconductor La/sub 1.85/Sr/sub 0.15/CuO_4. Fe deposition reduces the emission within ≅3 eV of the Fermi level, indicating disruption of the hybrid Cu 3d/sub x//sub <2/-y/sup =/—O 2p/sub x//sub ,//sub y/ states responsible for superconductivity. Strong reaction of Fe adatoms with substrate oxygen is observed for coverages ranging from 0.25 to 8 A, and oxygen is withdrawn to form Fe-O. The chemical states of Cu are selectively changed with a quenching of the Cu/sup 2+/ configuration but the persistence of the Cu/sup 1+/ configuration.

45782 **Soft x-ray absorption studies on high-T/sub c/ superconducting oxides.** Sondericker, D.; Fu, Z.; Johnston, D.C.; Eberhardt, W. (National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3983-3985(1 Sep 1987).

We report measurements of the Cu 2p, O 1s, and La 3d absorption edges in La_2CuO_{4-y} and a Sr-doped, superconducting sample of La/sub 1.8/Sr/sub 0.2/CuO_{4-y}. The Cu 2p absorption edge in the superconducting sample is considerably broader and exhibits additional structure compared to the normal La_2CuO_{4-y}. This additional structure is consistent with models for the superconductivity which involve different valence states of the Cu atoms or different spin configurations at the Cu sites. The oxygen edge exhibits fine structure which changes with sample preparation and is presumably due to oxygen defects in the samples.

45783 **Complete absence of isotope effect in $YBa_2Cu_3O_7$: Consequences for phonon-mediated superconductivity.** Bourne, L.C.; Zettl, A.; Barbee, T.W. III; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 3990-3993(1 Sep 1987).

$YBa_2Cu_3O_7$ has been prepared with enriched /sup 135/Ba, /sup 138/Ba, /sup 63/Cu, and /sup 65/Cu isotopes. The superconducting transition temperature T/sub c/ is found to be insensitive to the mass of the Ba and Cu atoms. This result, when combined with earlier findings of no T/sub c/ shift for oxygen-isotope substitution or rare-earth substitution, demonstrates the complete absence of an isotope effect in $YBa_2Cu_3O_7$. The consequences of these results for the applicability of phonon-mediated electron pairing mechanisms are discussed.

45784 **Large anisotropic critical magnetization currents in single-crystal $YBa_2Cu_3O_{7-\delta}$.** Crabtree, G.W.; Liu, J.Z.; Umezawa, A.; Kwok, W.K.; Sowers, C.H.; Malik, S.K.; Veal, B.W.; Lam, D.J.; Brodsky, M.B.; Downey, J.W. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 7, 4021-4024(1 Sep 1987).

Magnetization measurements on single crystals of $YBa_2Cu_3O_{7-\delta}$ slow strong anisotropic flux pinning with critical magnetization current densities of 1.4×10^6 A/cm^2. The critical magnetization currents fall sharply with temperature in

both single-crystal and polycrystalline samples. The high critical magnetization current densities can be reduced by nearly two orders of magnitude by annealing.

45785 Superconducting properties of aligned crystalline grains of $Y_1Ba_2Cu_3O$/sub 7-//sub δ/. Farrell, D.E.; Chandrasekhar, B.S.; DeGuire, M.R.; Fang, M.M.; Kogan, V.G.; Clem, J.R.; Finnemore, D.K. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 4025-4027(1 Sep 1987).

A new method has been used to produce uniaxially aligned small single crystals of $Y_1Ba_2Cu_3O$/sub 7-//sub δ/. The superconducting critical current deduced from magnetization data is strongly field dependent and highly anisotropic. In the basal plane at T = 4.2 K we estimate that the critical current at zero field is in excess of 10^7 A/cm^2.

45786 Ion-assisted deposition of lanthanum fluoride thin films. Targove, J.D.; Lehan, J.P.; Lingg, L.J.; Macleod, H.A.; Leavitt, J.A.; McIntyre L.C. Jr. (University of Arizona, Tucson, Arizona 85721). *Applied Optics;* **26**: No. 17, 3733-3737(1 Sep 1987).

Ion-assisted deposition has been used to deposit lanthanum fluoride thin films with near-unity film packing densities and no significant increase in absorption. Rutherford backscattering analysis has determined the effect of ion bombardment on the film stoichiometries including the degree of fluorine deficiency. Oxygen atoms or compounds appear to occupy most of the available anion vacancies if sufficient oxygen is available in the ion beam or the residual atmosphere.

45787 Observation of an oxygen isotope shift in the superconducting transition temperature of La/sub 1.85/Sr/sub 0.15/CuO_4. Faltens, T.A.; Ham, W.K.; Keller, S.W.; Leary, K.J.; Michaels, J.N.; Stacy, A.M.; zur Loye, H.; Morris, D.E.; Barbee III, T.W.; Bourne, L.C.; and others. (College of Chemistry, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **59**: No. 8, 915-918(24 Aug 1987). Contract AC03-76SF00098.

An oxygen isotope shift is observed in superconducting La/sub 1.85/Sr/sub 0.15/CuO_4 when /sup 18/O is substituted partially for /sup 16/O; the superconducting transition temperature T/sub c/ is lowered by 0.3 to 1.0 K in different samples. We examine these results using conventioanl phonon-mediated BCS theory and conclude that, for La/sub 1.85/Sr/sub 0.15/CuO_4, phonons play an important role in the pairing mechanism.

45788 Structural and dynamical studies of δ-Bi_2O^3 oxide ion conductors. III. Phase relationships in the system (Bi_2O_3)/sub 1-x/(M_2O_3)/sub x/ as a function of pressure and temperature (M = Y, Er, or Yb). Battle, P.D.; Hu, G.; Moroney, L.M.; Munro, D.C. (Univ. of Leeds, England). *Journal of Solid State Chemistry;* **69**: No. 1, 30-35(Jul 1987).

The authors report the results of a structural investigation of the nonstoichiometric solid solutions (Bi_2O_3)/sub 1-x/(M_2O_3)/sub x/ (M = Y, Er, or Yb) treated at temperatures of between 298 and 1023 K, and at pressures of up to 4 GPa. For x = 0.25 and M = Er or Y, 4 GPa pressure at 873 K causes the fluorite-related phase stable under ambient conditions to transform to a monoclinic phase which on subsequent annealing transforms to a rhombohedral phase isostructural with that adopted by the solid solution (Bi_2O_3)/sub 1-x/(Sm_2O_3)/sub x/ under ambient conditions. For x = 0.4 and M = Er or Y, application of 4 GPa at 1073 K causes the fluorite phase to undergo a distortion to another rhombohedral structure with a smaller unit cell. No transitions were found in the Yb^{3+}-doped system.

45789 Magnetic studies of high T/sub c/ superconducting (La/sub 0.9/Sr/sub 0.1/)$_2$CuO/sub 4-y/. Zirngiebl, E.; Thompson, J.D.; Huang, C.Y.; Hor, P.H.; Meng, R.L.; Chu, C.W.; Wu, M.K. (Los Alamos National Lab., NM). *Applied Physics Communications;* **7**: No. 1-2, 1-8(Mar-Jun 1987).

They have measured the magnetic moment of (La/sub 0.9/Sr/sub 0.1/)$_2$CuO/sub 4-y/ as a function of temperature and magnetic field and found magnetically the onset of superconductivity at a temperature T/sub CO/ similarly ordered 35K. At 2K, the dc magnetic susceptibility reaches 83% of perfect diamagnatism. From field studies, they have established that the sample is a type-II superconductor and that the temperature dependencies of the critical fields are anomalous.

45790 Failure prediction of hot-pressed Si/sub 3/N/sub 4/ ceramics by NDE. Singh, J.P.; Roberts, R.A.; Vaitekunas, J.J.; Ellingson, W.A. New York, NY; American Society of Mechanical Engineers (1987). 4p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-7.

Results are presented on the detection of critical flaws in hot-pressed Si/sub 3/N/sub 4/ with Fe inclusions by nondestructive evaluation (NDE) and fractographic observation. The NDE methods employed included, low-energy contact radiography with digital image enhancement, and through-transmission and back-scatter ultrasonic imaging. A comparison of NDE and fractography results indicates that the backscatter ultrasonic method may be more suitable than low-kV contact radiography for the detection of near-surface flaws.

45791 Advanced ultrasonic NDE methods for characterizing porosity in SiC. Kunerth, D.C.; Telschow, K.L. New York, NY; American Society of Mechanical Engineers (1987). 5p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-6.

Ultrasonic techniques are developed to detect and characterize porosity in advanced ceramic materials. The techniques use the acoustic backscatter resulting from the porosity of other anomalies and the ultrasonic signal timing and energy characteristics corresponding to propagation velocity and signal amplitude. Although all of the techniques are acoustic in nature, different signal processing algorithms provide different information about the porosity distribution. Four techniques are presented as well as experimental results from a sample of silicon carbide having a known porosity distribution. Information obtained from radiography and microscopic optical examination are compared with the ultrasonic results.

45792 Mixed-mode fracture criteria for reliability analysis and design with structural ceramics. Shetty, D.K. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-70.

Increasing use of ceramics in structural applications has led to the development of a probabilistic design methodology that combines three elements; linear elastic fracture mechanics theory that relates strengths of ceramics to size, shape and orientation of critical flaws, a characteristic flaw size distribution function that accounts for the size effect on strength via the weakest-link concept, and a time dependent strength caused by subcritical crack growth or other mechanisms. This paper reviews recent research that is focussed on the first of the above three elements, viz. investigation of fracture criteria for arbitrarily oriented flaws in ceramics, i.e. the mixed-mode fracture problem in linear elastic fracture mechanics theory. Experimental results obtained with the two-dimensional through-cracks and the three-dimensional surface (indentation) cracks are summarized and compared to the mixed-mode fracture criteria. The effects of material microstructure and the stress state on mixed-mode fracture are discussed. The application of the mixed-mode fracture criteria in reliability analysis is illustrated for several simple stress states in the absence of time-dependent strength degradation.

45793 **Erosion of hard material coating systems.** Levy, A.V.; Wang, B. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 477-496 of Wear of materials - 1987. Ludema, K.C. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870476—). Contract AC03-76SF00098.

From International conference on wear of materials; Houston, TX, USA (5 Apr 1987).

The use of coating systems to protect structural metal surfaces from elevated temperature small, solid particle erosion and erosion-corrosion can extend component life and permit operation in more severe environments. The room and elevated temperature erosion behavior of several hard material coating systems, i.e., carbides, borides, nitrides, were determined over a range of test conditions. Particle velocities from 70 to 150 m/s and test temperatures from 25° to 540°C were used. Mechanisms of erosion were established and related to erosion rates in a manner that defined the related to erosion rates in a manner that defined the requirements of composition, morphology and defect levels of coating systems for long term performance. It was determined that small grain size, low porosity and absence of cracks were microstructural features that enhanced erosion resistance. Hardness levels and the composition and distribution of second phase, hard particles had less effect on coating performance. Angular silicon carbide particles were considerably more erosive than either alumina or chromite/mixed oxide round shaped particles and the rankings of the coatings' performance were different for each erodent and set of test conditions.

45794 **Wear of an alumina-silicon carbide whisker composite.** Yust, C.S.; Leitnaker, J.M.; De Vore, C.E. (Oak Ridge National Lab., Oak Ridge, TN). pp 277-284 of Wear of materials - 1987. Ludema, K.C. New York, NY; American Society of Mechanical Engineers (1987). (CONF-870476—). Contract AC05-84OR21400.

From International conference on wear of materials; Houston, TX, USA (5 Apr 1987).

Improvement of the mechanical properties of ceramics may be achieved by the incorporation of additional phases in the microstructure. In some microstructures, the added phase serves primarily as a mechanical barrier to the passage of cracks, while other incorporated phases depend on phase transformations and localized stress field generation for crack inhibition. An example of the former type of strengthening is the inclusion of fibers or whiskers into crack sensitive matrices. The flexure strength and fracture toughness of alumina are tangibly improved by the addition of silicon carbide whiskers, and the improved mechanical characteristics offer encouragement for the use of the composite as a wear resistant component material in numerous industrial applications from heat engines to pump seals. This paper reports an initial investigation of the unlubricated sliding wear behavior of an alumina-silicon carbide composite.

45795 **Low-temperature fired lead magnesium niobate.** Swartz, S.L.; Dayton, G.O.; Laubscher, D.K. (Materials Research Lab., Pennsylvania State Univ.). pp 153-156 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Lead magnesium niobate-lead titanate (PMN-PT) ceramics have been sintered at low temperatures by PbO atmosphere control, or with additions of excess PbO. The densification and dielectric properties were extremely sensitive to sintering conditions and/or the amount of excess PbO. Stoichiometric PMN-PT ceramics could not be densified at 1000°C in air, due to PbO volatilization. However, when sintered in a PbO atmosphere, densities approaching 98% theoretical were achieved at 1000°C, with maximum dielectric constants of 17500. Excess PbO (1 and 3 wt%) allowed for PMN-PT ceramics to be densified at temperatures as low as 900°C in air. However, samples sintered with excess PbO exhibited inferior dielectric properties (lower dielectric constants and transition temperatures, along with significant dielectric ageing), even though most of the PbO was driven off during sintering.

45796 **Growth and dielectric properties of lead barium niobate single crystals and morphotropic phase boundary.** Adachi, M.; Sankar, S.G.; Bhalla, A.S.; Chang, Z.P.; Cross, L.E. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 169-171 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Single crystals of lead barium niobate (PBN) belonging to the tetragonal tungsten bronze structures possess many desirable properties for potential applications in electro-optic, piezoelectric and pyroelectric devices. In the solid solution PbNb/sub 2/O/sub 6/-BaNb/sub 2/O/sub 6/, substitution of barium for lead first decreases the orthorhombic distortion and later stabilizes the tetragonal structure. A morphotropic phase boundary exists at about Pb/sub 0.6/Ba/sub 0.4/Nb/sub 2/O/sub 6/. Current understanding based on phenomenological calculations on related materials indicate that electro-optic and dielectric properties of PBN should exhibit considerable enhancement near the morphotropic phase boundary and that they should be largely temperature-independent over a reasonably large range of temperature.

45797 **Crystal growth, phase transformation studies, and micro-cracking in single crystal lead titanate.** Suchicital, C.T.A.; Payne, D.A.; Grandin, A. (Dept. of Ceramic Engineering and Materials Research Lab., Univ. of Illinois at Urbana-Champaign, Urbana, IL 61801). pp 465-468 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—). Contract AC02-76ER01198.

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Single crystals of lead titanate were grown by a flux method at significantly reduced temperatures so as to avoid the disruptive phase transformation at 500°C. Data are reported for the characterization of the isomorphic crystals which were typically up to 4 mm on a side. Hot stage optical microscopy and TEM methods were used to examine the nucleation and growth of a- and c-type domains in previously single domain regions. Observations are reported for the domain characteristics and the formation of micro-cracks at domain intersections. The effect of repeated thermal cycling around the phase transition temperature, on the propagation and growth of cracks to failure, is discussed.

45798 **Growth, dielectric and pyroelectric properties of 0.9Pb(Zn/sub 1/3/Nb/sub 2/3/)O/sub 3/-0.1PbTiO/sub 3/ single crystals.** Chang, Z.P.; Bhalla, A.S.; Cross, L.E. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 482-484 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Single crystals of 0.9Pb(Zn/sub 1/3/Nb/sub 2/3/)O/sub 3-/0.1PbTiO/sub 3/ were grown using the flux method. The dielectric property along the pseudocubic [111] and [100] directions was measured as a function of temperature and frequency. The effects of poling and DC bias field were investigated. The pyroelectric property along these two directions was also measured.

45799 **Electron microscopy characterization of lead zirconate titanate ceramics at the morphotropic phase boundary composition.** Dass, M.L.A.; Dahmen, U.; Thomas, G.; Yamamoto, T.; Okazaki, K. (Dept. of Materials Science and Mineral Engineering and Materials and Molecular Research Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 146-149 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Lead zirconate titanate (PZT) ceramics exhibit excellent dielectric and piezoelectric properties at the morphotropic phase boundary (MPB) composition and it is believed that this is due to the coexistence of tetragonal (T) and rhombohedral (R) phases resulting in easy poling. However only limited microstructural information is available at this boundary composition. In the present study the structure and chemical composition of PZT ceramics prepared by conventional ceramic processing has been analyzed by electron microscopy. Lattice parameters obtained from X-ray diffraction indicate that the T and R phases are only very slightly distorted from cubic symmetry at the MPB composition. Convergent beam diffraction (CBD) has been used to analyze the structure at the MPB composition using the fact that the symmetry of the CBD pattern is sensitive to the point group of the space lattice.

45800 **Electrical properties of grain-grown PLZT ceramics.** Huang, D.N.; Yin, Z.W.; Cross, L.E. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 159-164 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

8/65/35 PLZT ceramics with different grain size distribution were prepared by long time heat treatments in a PbO atmosphere. After thermal etching, image analyses were carried out for these specimens and their electrical properties were measured. Experimental results showed that the grain boundaries give rise to large effects on the electrical properties of the PLZT ceramics. An explanation for the grain boundary effects in these PLZT is suggested.

45801 **Piezoelectric properties and microstructure of glass-ceramics in the BaO-SrO-SiO/sub 2/-TiO/sub 2/ system.** Ylo, E.E. III; Wheeler, M.; Halliyal, A.; Bhalla, A.S.; Newnham, R.E. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 406-409 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Previous studies have shown that fresnoite (Ba/sub 2/TiSi/sub 2/O/sub 8/) glass-ceramics with oriented crystallites are promising candidate materials for pyroelectric detectors and surface acoustic wave devices. A detailed investigation of the properties and microstructure of glass-ceramics in the Ba/sub 2/-xSrxTiSi/sub 2/O/sub 8/ solid solution has been carried out. Glasses of several compositions were prepared and recrystallized through a heating schedule to produce an oriented region of crystallites perpendicular to the surface, 100-500μm in depth. The microstructure of the glass-ceramics was examined by scanning electron microscopy. Their dielectric and piezoelectric properties were studied.

45802 **Dielectric and piezoelectric properties of Pb(Zn/sub 1/3/Nb/sub 2/3/)O/sub 3/-PbTiO/sub 3/-BaTiO/sub 3/ ceramics.** Baumler, S.L.; Halliyal, A.; Newnham, R.E. (Materials Research Lab., Pennsylvania State Univ., University Park, PA 16802). pp 418-421 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Previous studies in the (1-x)Pb(Zn/sub 1/3/Nb/sub 2/3/O/sub 3/-xPbTiO/sub 3/ system have shown the existence of a morphotropic phase boundary near x=0.09. Single crystals of this composition grown in the perovskite form using PbO flux method show excellent piezoelectric and dielectric properties. However, it is difficult to prepare polycrystalline ceramics near the morphotropic phase boundary because of the stability of a competing lead niobate pyrochlore phase. Recently, it has been shown that the formation of the pyrochlore phase can be suppressed by the addition of a small amount of BaTiO/sub 3/. In the present study, compositions near the morphotropic phase boundary were prepared in the perovskite form by the addition of 5 mole percent BaTiO/sub 3/. The location of the morphotropic phase boundary and the dielectric and piezoelectric properties of selected compositions in this system are described.

45803 **SAW transduction in electrostrictive substrates.** Laguna, G.R.; Auld, B.A. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). pp 589-592 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

Using electrostrictive materials for surface acoustic wave (SAW) device substrates allows for electronic control of the frequency response of the device. Centrosymmetric materials will not be piezoelectric, but by applying a static DC biasing electric field, a piezoelectric response can be induced in the substrate. If this bias field is spatially varying, then the induced piezoelectric response will also be spatially varying. In fact, since the piezoelectric response is controlled by the DC biasing electric field, changing the bias distribution will change the response of the filter. This allows for a real-time electronically programmable SAW device. The constitutive relations for pure electrostrictive materials are manipulated to show this induced piezoelectric response under an applied electric bias field.

45804 **Dielectric aging effects in doped lead magnesium niobate: Lead titanate relaxor ferroelectric ceramics.** Pan, W.; Dayton, G.O.; Cross, L.E. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). pp 645-647 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

No obvious dielectric aging effects have been observed in pure .9Pb(Mg/sub 1/3/Nb/sub 2/3/)O/sub 3/-.1PbTiO/sub 3/ relaxor ferroelectric ceramics in this study. The addition of small amounts of MnO however, induces aging effects. Aging effects preferentially reduce the dispersive component of the weak field permittivities above the aging temperature. Isothermal aging rates are observed to increase with increasing doping level. Dielectric constant vs the logarithm of time at constant temperature level out with time. The origin of aging for this type of relaxor material can be explained in terms of the volume stabilization of the polar vectors in polar micro-regions by the defect dipoles introduced by the doping.

3606 Other Materials

REFER ALSO TO CITATION(S) 45228, 45248, 45385, 45387, 45495, 45503, 45922, 46012, 46023, 46033, 46038, 46039, 46124, 46381, 46760, 46766, 46769, 46770, 46771, 46774, 46777, 46921, 46978

45805 (ATR—86(8139)-3) Heavy ion induced upsets in semiconductor devices. Koga, R.; Kolasinski, W. A.; Imamoto, S. (Aerospace Corp., El Segundo, CA (USA)). Aug 1986. 28p. NTIS, PC A03/MF A01.

Heavy ions produced at various accelerator facilities have been employed to measure the effect of cosmic rays on semiconductor devices in space. An ion transmission counter, a solid state detector, and a position sensitive detector constitute the beam-monitor system used to measure the flux in real time and to monitor the spatial beam uniformity. An LSI 11/23 computer exercises the semiconductor devices under test. The experimental technique and test results are discussed.

45806 (CONF-870747—1) Applications and limitations of deuterium labeling methods to neutron scattering studies of polymers. Wignall, G.D.; Bates, F.S. (Oak Ridge National Lab., TN (USA); Bell Labs., Murray Hill, NJ (USA)). 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012936.

From 10. discussion conference on small-angle scattering and related methods; Prague, Czechoslovakia (13 Jul 1987).

Deuterium labeling techniques have been widely used to study polymer chain configuration and motion, based on the assumption that the H- and D- chains are thermodynamically identical and that the interaction parameter between them, chi/sub HD/ is zero. By an appropriate choice of the degree of polymerization and temperature, both critical scattering and phase separation can be made to occur, due solely to the small but finite thermodynamic differences between protonated and deuterated molecules. These experiments helped delineate the range of validity of the assumptions which had been used hitherto in neutron scattering studies of polymers. The majority of previous experiments, carried out at modest molecular weights, have been shown to be in large part unaffected by such effects. 84 refs., 8 figs.

45807 (CONF-871027—6) Ceramic composites by chemical vapor infiltration. Stinton, D.P. (Oak Ridge National Lab., TN (USA)). 18 Oct 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009128.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Composites consisting of silicon carbide matrices reinforced with continuous ceramic fibers are being developed for high-temperature structural applications. Chemical vapor deposition (CVD) techniques are very effective in fabricating composites with high strengths and exceptional fracture toughness. Mechanical properties of infiltrated composites are controlled by the strength of the interfacial bond between the fibers and matrix. This paper describes two CVD techniques and reviews the models being developed to better understand and control the infiltration process.

45808 (CONF-871027—7-Summ.) DSA RuO_2/TiO_2 electrode modeled by ion implantation: An in situ characterization by photoacoustic and photocurrent spectroscopy. Vallet, C.E.; Borns, S.E.; Hendrickson, J.S.; White, C.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 2p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009129.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

This paper presents a first attempt at in situ characterization of very thin passive layers forming at implanted Ru/Ti alloys by photoacoustic and photocurrent spectroscopies. The photoacoustic spectroscopy gives the optical absorption of the layer. Changes in the spectra in the wavelength region including the absorption band edge of semiconducting n-TiO_2 with the Ru concentration should provide a means for monitoring the transition from a semiconducting electrode (at low Ru concentration) to a metallic electrode as the Ru concentration within the oxide increases. The associated photocurrent result is a further test that the monitored optical transition corresponds to the excitation of electrons across the gap from valence to conduction band. 5 refs., 2 figs.

45809 (DOE/ER/13154—9) Experimental and theoretical study of condensation in multicomponent vapors: Quarterly report No. 9 for 15 February 1986-14 May 1986. Wilemski, G. (Physical Sciences, Inc., Andover, MA (USA)). Jul 1987. Contract AC02-84ER13154. 7p. (PSI—154/TR-691). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013663.

The program is primarily experimental, but a significant amount of supporting theoretical work is also being performed. The experiments are studying the homogeneous nucleation and subsequent growth of mixed clusters formed during the supersonic expansion of gas mixtures containing pairs of mutually condensible species. Theoretical work is concentrating on the calculation of nucleation rates under conditions pertinent to the experiments. A new thermodynamic model for binary cluster composition is being used as a basis for a revised classical theory of binary nucleation rates. Rates calculated with this revised theory, as well as with the standard theory and other existing theories, are being compared with the supersonic expansion data and with data obtained from diffusion cloud chambers and shock tubes to assess adequacy of the various theories. This report covers recent theoretical work on the thermodynamic consistency of binary nucleation theories. 12 refs., 1 fig.

45810 (INIS-SU—420, pp 85-86) Specific heat of cadmium selenide in the temperature range 360-760 K. Glazov, V.M.; Pashinkin, A.S.; Malkova, A.S.; Lubashevskaya, I.V. (Moskovskij Inst. Ehlektronnoj Tekhniki, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780144. (CONF-8606301—Pt.2-Summ.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45811 (INIS-SU—423, pp 136-137) Determination of Bi_2Te_3 sublimation enthalpies and entropies according to the data of mass spectrometric study of Bi-Te system. Aleshina, E.A.; Zlomanov, V.P.; Demidova, E.D.; Plotnikov, M.V.; Novoselova, A.V. (Moskovskij Gosudarstvennyj Univ., USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45812 (LA-UR—87-2465) Radiation-induced transient attenuation of optical fibers at 800 and 1300 nm. Looney, L.D.; Lyons, P.B. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-870584—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013165.

From Society of Photo-Optical Instrumentation Engineers conference; Orlando, FL, USA (17 May 1987).

Radiation-induced absorption in optical fibers has been a subject of considerable interest throughout the world. As availability and applications of fibers have evolved from "first window" systems operating near 850 nm to "second window" systems near 1300 nm, interest in wavelength dependence of radiation effects in optical fibers has similarly evolved. The present work summarizes second-window, radiation-induced transient absorption measurements in optical fibers for times shorter than 5 μs. Comparisons to first window data for these fibers are also presented. Only high purity silica fibers with low-OH concentrations were used in the present study to avoid the large OH absorption band in this region. This paper also collects first window data on several high-OH optical fibers.

45813 (LBL—23692) Electrical properties of high T/sub c/ superconductors under high pressures. Erskine, D.; Hess, E.; Yu, P.Y.; Stacy, A.M.; Zettl, A.; Cohen, M.L. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 8p. (CONF-870682—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012818.

From Workshop on novel mechanisms for superconductivity; Berkeley, CA, USA (22 Jun 1987).

Pressure has played a significant role in the recent developments of high transition temperature (T/sub c/) superconductors. This document reports electrical resistance measurements in these new superconductors at pressures up to 16 GPa. Our measurements were performed on single-phase but polycrystalline samples of La/sub 1.85/Ba/sub 0.15/CuO_4, La/sub 1.85/Sr/sub 0.15/CuO_4 and YBa_3Cu_4O/sub 7.5/. The samples were typically small fragments of about 200 microns across obtained by crushing larger pellets which have been characterized by x-ray, resistivity and magnetic susceptibility measurements at ambient pressure. Quasi-hydrostatic pressure was applied with a diamond anvil high pressure cell. The sample was surrounded by $CaSO_4$ powder as the pressure medium and the pressure was determined by the standard ruby fluorescence technique. Diamond anvils of three different sizes have been utilized to cover these three pressure ranges: 0 to 5 GPa, 2 to 10 GPa, and 3 to 20 GPa. The resistance of the sample was determined by a quasi-four-probe technique via two loops of copper wires. Electrical contact between the copper wire and the sample was achieved by pressure. 9 refs., 1 fig.

45814 **(N—87-24211) Development of a theoretical model for annealing of radiation damage in semiconductor devices. Quarterly report, 8 March-8 June 1987.** Litovchenko, V. (Catholic Univ. of America, Washington, DC). Jun 1987. 5p. (NASA-CR—180394; NAS—1.26:180394; Q—2). NTIS, PC A02/MF A01.

The radiation response of Metal Oxide Semiconductor (MOS) devices and Integrated Circuits (ICs) was studied theoretically. The case of short-term annealing and the rebound effect are modeled mathematically using the linear response theory.

45815 **(SAND—86-2983C) An experimental and theoretical study of the bending behavior of Kevlar 49/epoxy beams and rings.** Guess, T.R.; Reedy, E.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-871082—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010430.

From 19. national SAMPE technical conference; Washington, DC, USA (13 Oct 1987).

The basic lamina properties were determined by testing unidirectionally reinforced specimens in tension and compression. Results indicate that unidirectional Kevlar 49/epoxy composites manifest nearly linear elastic response in tension and yield-like behavior in fiber-directed compression. The measured compressive yield strength is roughly 20% of the tensile ultimate strength. We also tested 3.2 and 12.7 mm thick, quasi-isotropic beams in tension, compression, short beam shear, and four-point bending, and 457 mm diameter, 12.7 mm thick, quasi-isotropic rings in diametral compression. All specimens were fully instrumented with strain gages to provide a detailed record of their deformation. As anticipated, the flexural response of laminated Kevlar 49/epoxy beams and rings exhibit nonlinearity. For this reason, a material model which includes compressive yield behavior was examined. In this model, a Kevlar 49 lamina is assumed to respond in a linear elastic manner to all loads except compression in the fiber direction. In fiber-directed compression, it is assumed to behave in an elastic-perfectly plastic manner. Laminate response is determined from the postulated lamina behavior in a manner analogous to that used in classical laminated plate theory. This constitutive model was used in conjunction with the ABAQUS finite element code to analyze the tested specimens. Comparison of predicted results with experimental data corroborates the model's ability to reproduce much of the observed nonlinear behavior.

45816 **(SAND—87-0028C) The applicability of equilibrium calculations to dichlorosilane CVD [chemical vapor deposition].** Medernach, J.W.; Ho, P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-871027—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007775.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Equilibrium calculations were made for the chlorosilane (Si-H-Cl) system over a wide range of temperatures, pressures, and Si/Cl ratios. The Si/Cl ratios are presented as a function of the Cl/H ratio, temperature and pressure. Three-dimensional contour plots of the equilibrium Si/Cl also give a qualitative picture. Comparison of observed and equilibrium deposition rates indicate the range of applicability for the chlorosilane system. Results of this study indicate that equilibrium calculations can serve as a useful guide for silicon deposition from dichlorosilane at temperatures >1000°C and pressures between 625 and 80 Torr. An application related to the silicon-on insulator (SOI) technology is presented. 16 refs., 4 figs.

45817 **(SAND—87-0426C) Effect of tertiary hydrogens on the stability of an ionic membrane in a chemically aggressive environment.** Assink, R.A.; Arnold, C. Jr.; Hollandsworth, R.P. (Sandia National Labs., Albuquerque, NM (USA); Lockheed Missiles and Space Co., Palo Alto, CA (USA)). 18 Oct 1987. Contract AC04-76DP00789. 11p. (CONF-871027—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87007021.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Electrochemical devices often utilize ionic separator membranes. In these applications, high conductivity, high selectivity and good durability in chemically aggressive environments are needed. Purpose of this program is to develop improved ionic membranes for these environments and to evaluate their performance and stability. Degradation of the active site has tentatively been attributed to the presence of tertiary hydrogens which are susceptible to oxidative attack. In this study the effect of replacing the tertiary hydrogen by a methyl group was evaluated. Both model compounds and radiation grafted membranes were examined. Results show that membrane stability can be substantially increased by elimination of tertiary hydrogens.

45818 **(SAND—87-1098C) Chemical vapor deposition of B_6P and B_6As films.** Aselage, T.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 3p. (CONF-871027—11). NTIS, PC A02. File Number DE87009288.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Boron phosphide and boron arsenide films are deposited on Si (100) surfaces using hydrogen reduction of chloride reactants. The deposition system utilizes a quartz bell jar in a vertical configuration. The Si wafer is placed on a B_4C-coated graphite susceptor. The susceptor is heated by rf induction and the temperature of the susceptor is monitored with an optical pyrometer. The susceptor temperature was held at 1200°C and the hydrogen flow at 2.5 l/min. The boron trichloride flow was fixed at 1.5 sccm, while the phosphorus trichloride flow was varied from 3- to 6-fold excess. Deposition times from 5 to 45 minutes have resulted in B_6P films ranging from ≃1000 A to 1.2 μm in thickness, with a linear deposition rate of about 250 A/min. Thin films are transparent, while thicker films are cloudy in appearence. Chemical vapor deposition has been shown to produce B_6P films on Si that are highly oriented and transparent. 6 refs., 1 fig.

45819 **(SAND—87-7010) Ohmic contacting schemes to gallium arsenide devices.** (California Inst. of Tech., Pasadena (USA); Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014627.

The goal of this project was to design ohmic contacting schemes to gallium arsenide that would sustain 400°C for 1 hour and 600°C for 15 minutes without significant degradation. Our approach uses a generic contacting scheme calling for two thin-film layers between the semiconducting substrate and the metal overlayer: (1) a contacting layer adjacent to the semiconductor that determines the electrical properties of the contact and (2) a diffusion barrier layer adjacent to the metal overlayer that assures the thermal stability of the contact. A contact designed according to this scheme (silver overlayer, pure tungsten or tungsten-nitrogen layer as the diffusion barrier, and a magnesium-doped platinum film for the contacting layer to p-type gallium arsenide) changes little upon annealing at 550°C for 5 hours. The contact resistivity is on the order of 1E-3 ohmcm² or less.

45820 **(SERI/STR—211-3173) The preparation of thin films for photovoltaic conversion by novel MOCVD techniques: Final subcontract report, March 1987.** Saunders, A.; Tyrrell, G.; Vecht, A. (Phosphor Consultants, London (UK); Solar Energy Research Inst., Golden, CO (USA)). Jun 1987. Contract AC02-83CH10093. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001185.

Details are presented for the chemical vapour deposition of a range of thin film materials for potential photovoltaic device applications. It is shown that the CVD/MOCVD approach is capable of yielding thin films of ZnO(In), Zn/sub x/Cd/sub 1-x/S.(In), and the binary and ternary sulfides and selenides of copper and indium. In addition to the presentation of essential deposition conditions, structural and compositional data are given and, where applicable, optical and electrical characteristics.

45821 **(UCID—20839-87-2) Anti-abrasion protection with highly organized materials.** Steele, W.A.; Leider, H.R.; Mohr, P.B. (Lawrence Livermore National Lab., CA (USA)). 30 Jun 1987. Contract W-7405-ENG-48. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014238.

Abrasion and impact resistance are a prime requirement for many materials applications. To best protect plastic or metal-based composites from abrasion and impact, a surface coating that is simultaneously very hard and highly yielding is necessary. Both these requirements can be met by a dense pattern of emergent fibers or high L/D ratios, well rooted but with one end free, i.e., hair. A covering of such hair, with fibers long enough to accommodate themselves to impacting objects, will give substantial protection against impact or particle abrasion. 2 figs.

45822 **(UCRL—94146) Rheological and aging characterization of elastomers.** Feng, W.W. (Lawrence Livermore National Lab., CA (USA)). 1 Jan 1987. Contract W-7405-ENG-48. 11p. (CONF-870466—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009598.

From International conference on environmental degradation of engineering materials; University Park, PA, USA (13 Apr 1987).

We developed a constitutive equation for the viscoelastic and aging characteristics of elastomers subjected to large deformations. An experiment is designed for determining these mechanical properties quantitatively. 2 refs., 5 figs.

45823 **(UCRL—96768) Nitrogen at high pressure.** Nellis, W.J. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-870753—68). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013797.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

High-pressure results for nitrogen are reviewed and discussed in terms of phenomena that occur at extreme conditions. Included are: equation of state in shock compression, dissociation, pressure effects on Raman spectra and mp, etc.

45824 **Refinements in the determination of minority-carrier diffusion length measurements of polycrystalline silicon materials by the surface photovoltage method.** Yan, R.; Wang, F.F.Y.; Corderman, R.R.; Khattak, C.P.; Leipold M.H. Jr. (Department of Materials Science and Engineering, State University of New York at Stony Brook, Stony Brook, New York 11794-2275). *Journal of Applied Physics;* **62**: No. 8, 3249-3252(15 Oct 1987).

The microstructures of polycrystalline silicon samples show significant differences in their absorption coefficients within the range of wavelength of interest for the surface photovoltage (SPV) method. The accuracy in the determination of the minority-carrier diffusion length of polycrystalline materials by the SPV method was demonstrably improved with the use of the determined absorption coefficients for each individual sample.

45825 **Aerosol clearing model for a high-energy laser beam propagating through vaporizing media.** Chitanvis, S.M.; Gerstl, S.A.W. (Los Alamos National Laboratory, Theoretical Division, MS-P371, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **62**: No. 8, 3091-3096(15 Oct 1987).

We describe the clearing phenomenon that occurs when a continuous wave (cw) high-energy laser beam, incident upon a cloud of hygroscopic droplets, vaporizes these droplets. We consider the case when the incident wavelength is greater than the average droplet radius. The model of F. A. Williams [Int. J. Heat Mass Transfer 8, 575 (1965)] is used to describe the vaporization of a single droplet. The propagation of the laser beam is described by the radiative transfer equation in one dimension. We establish the existence of an "inertial" characteristic time t/sub i/ that it takes for evaporation to be established in an aerosol cloud. Agreement of our model with a set of experimental data on vaporizing fog is demonstrated.

45826 **Electronic properties of sol-gel-derived oxides on silicon.** Weimer, R.A.; Lenahan, P.M.; Marchione, T.A.; Brinker, C.J. (Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, Pennsylvania 16802). *Applied Physics Letters;* **51**: No. 15, 1179-1181(12 Oct 1987).

Sol-gel-derived SiO_2, borosilicate, and aluminosilicate thin films deposited on silicon and heated for 5 min at temperatures of 1000 °C or lower exhibit dielectric strength as great as 5 MV/cm and interface state densities as low as $\sim 1 \times 10^{11}/cm^2$ eV. These values represent significant improvements over previous sol-gel-derived oxides on semiconductors and indicate that sol-gel processing can provide device quality oxides in situations where native oxides are unavailable or exhibit poor dielectric behavior, e.g., amorphous, hydrogenated silicon or III-V compound semiconductors.

45827 **Edge-cladding glasses for solid-state laser garnet crystals.** Meissner, H.E.; Toratani, H.; Izumitani, T.; Stokowski, S.E. (Hoya Optics, Inc., 3400 Edison Way, Fremont, California 94538-6190). *Journal of Applied Physics;* **62**: No. 7, 2646-2650(1 Oct 1987).

A range of glass compositions has been identified in the PbO-Bi_2O_3-CuO-Al_2O_3-SiO_2 system which will be applied as absorbent claddings to Nd^{3+} and Cr^{3+} co-doped gadolinium scandium gallium garnet and Nd^{3+}-doped gadolinium gallium garnet crystal slabs for high-power laser applications. Coefficients of thermal expansion and refractive indices at 1.06 μm of the cladding match those of the crystals. Absorption coefficients are between 30 and 40 cm^{-1}. Estimates of stress birefringence in the crystalline medium indicate that values below 10 nm/cm are achievable with cladding layers of 1 mm thickness and crystal slabs of 50—100 mm width.

45828 **Influence of junctions on photoluminescence decay in thin-film devices.** Ahrenkiel, R.K. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). *Journal of Applied Physics;* **62**: No. 7, 2937-2941(1 Oct 1987). Contract AC02-83CH10093.

The photoluminescence lifetime of III-V thin films is a major tool for the determination of minority-carrier lifetime. Prior work has dealt with the effects of surface recombination for various device geometries. Other work has shown the effect of self-absorption and photon recycling on the effective lifetime. We describe deep homojunctions thin-film devices. Model calculations show that the effective lifetime, as measured in the photoluminescence experiment, is always less than the bulk minority-carrier lifetime. In high-mobility materials, the effective photoluminescence lifetime may be dominated by diffusion and unrelated to recombination. An analysis of the data produces the minority-carrier mobility.

45829 **CO_2 laser processing of diffusion induced lattice imperfections in silicon: Experiment and theory.** James, R.B.; Geist, G.A.; Young, R.T.; Christie, W.H.; Greulich, F.A. (Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **62**: No. 7, 2981-2988(1 Oct 1987).

The high-temperature diffusion of phosphorus into crystalline silicon causes the formation of electrically inactive phosphorus-rich precipitates near the surface. These precipitates decrease the carrier lifetime and mobility in the diffused layer, and thus lead to less than optimal diode characteristics of electrical junctions formed by diffusion of phosphorus into a p-type substrate. We show that the free-carrier absorption of a CO_2 laser pulse can be used to completely dissolve the precipitates and remove dislocations in the diffused layer. Furthermore, we find that there are distinct advantages in depositing the pulse energy by way of free-carrier transitions, since the energy can be preferentially deposited in either confined doped layers or diffusion wells that are surrounded by lightly doped material. Our transmission electron microscopy results show that the annealing of the extended lattice defects is caused by melting of the near-surface region and subsequent liquid-phase epitaxial regrowth. Van der Pauw measurements are used to study the carrier concentration, mobility, and sheet resistivity of the samples before and after laser irradiation. The results of the electrical measurements show that there is a large increase in the carrier concentrations and a corresponding drop in the sheet resistivities of the laser irradiated samples. Using a Fourier transform

45830 **Slow aggregation of colloidal silica.** Martin, J.E. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185-5800). *Physical Review [Section] A: General Physics;* **36**: No. 7, 3415-3426(1 Oct 1987).

We report the results of elastic and quasielastic light scattering measurements on dilute aggregates of colloidal silica. The elastic scattering measurements indicate a fractal dimension of 2.05 +- 0.06, in agreement with previous results, but the quasielastic measurements demonstrate several novel characteristics. First, it is found that the linewidth Γ scales as a fractional power, Γ—q/sup 2.7/, of the momentum transfer q. Second, the inverse average relaxation time, defined as the integral of the field autocorrelation function, does not scale with the same power of q as the linewidth, implying that the autocorrelation functions cannot be scaled by a single nondimensioned time. Third, "stretched" exponential behavior is found for the long-time behavior of the autocorrelation function. These observations are interpreted in terms of a power-law polydisperse ensemble of aggregate clusters, with a number distribution of the form N(m)—m⁻/sup tau/, where tau = 1.9—2. Finally, the kinetics of growth are studied and the average radius is found to grow exponentially with time. These results are shown to be consistent, in part, with the predictions of the Smoluchowski equation and with simulations of aggregation.

45831 **Critical layer thickness in In/sub 0.2/Ga/sub 0.8/As/GaAs single strained quantum well structures.** Fritz, I.J.; Gourley, P.L.; Dawson, L.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 13, 1004-1006(28 Sep 1987). Contract AC04-76DP00789.

We report accurate determination of the critical layer thickness (CLT) for single strained-layer epitaxy in the InGaAs/GaAs system. Our samples were molecular beam epitaxially grown, selectively doped, single quantum well structures comprising a strained In/sub 0.2/Ga/sub 0.8/As layer imbedded in GaAs. We determined the CLT by two sensitive techniques: Hall-effect measurements at 77 K and photoluminescence microscopy. Both techniques indicate a CLT of about 20 nm. This value is close to that determined previously (—15 nm) for comparable strained-layer superlattices, but considerably less than the value of —45 nm suggested by recent x-ray rocking-curve measurements. We show by a simple calculation that photoluminescence microscopy is more than two orders of magnitude more sensitive to dislocations than x-ray diffraction. Our results re-emphasize the necessity of using high-sensitivity techniques for accurate determination of critical layer thicknesses.

45832 **SiO_2/Si interface probed with a variable-energy positron beam.** Nielsen, B.; Lynn, K.G.; Chen, Y.; Welch, D.O. (Brookhaven National Laboratory, Upton, New York 11973). *Applied Physics Letters;* **51**: No. 13, 1022-1023(28 Sep 1987). Contract AC02-76CH00016.

The annihilation characteristics of a monoenergetic beam of positrons, after implantation in Si with a 350-nm overlayer of SiO_2, were measured as a function of mean implantation depth. Positrons implanted overlapping the SiO_2/Si interface were observed to decay from a state with properties distinctively different from the state in bulk Si and the thermally grown SiO_2, i.e., a positron interface state. The momentum distribution of the annihilating positron-electron pair, as observed in the Doppler broadening of the annihilation line, is much broader for this state than for either bulk Si or SiO_2, in contrast to previously observed localized positron states in solids and at surfaces which show a narrower distribution.

45833 **Structure of porous Vycor glass.** Wiltzius, P.; Bates, F.S.; Dierker, S.B.; Wignall, G.D. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review [Section] A: General Physics;* **36**: No. 6, 2991-2994(15 Sep 1987).

Small-angle neutron scattering experiments investigating the structure of porous Vycor glass are reported. The long-wave-length behavior (0.004 A/sup -1/≦q≦0.025 A/sup -1/) of the measured structure factor S(q) is in good agreement with Cahn's prediction for spinodal decomposition. The high-q data do not conclusively establish whether the internal surfaces are fractally rough over the length scales probed. Experiments on Vycor contrasted with protonated and deuterated cyclohexane reveal local composition gradients within the glass.

45834 **Photocapacitance study of pressure-induced deep donors in GaAs:Si.** Li, M.F.; Yu, P.Y.; Weber, E.R.; Hansen, W. (Department of Physics, University of California, California 94720). *Physical Review [Section] B: Condensed Matter;* **36**: No. 8, 4531-4534(15 Sep 1987).

Photocapacitance transient measurements in GaAs:Si under pressures of 33 and 38 kbar are reported for the first time. The optical ionization energy of pressure-induced deep donors in GaAs was determined to be 1.44 +- 0.04 eV. The low-temperature capture times of photoexcited carriers were also measured and the results indicate that persistent photoconductivity would occur in GaAs under pressures in excess of 30 kbar. These results show that qualitatively the pressure-induced deep donors in GaAs are very similar to the DX centers in Ga/sub 1-//sub x/Al/sub x/As alloys in terms of their optical properties.

45835 **Pressure dependence of deep electronic levels in semiconductors: The oxygen-vacancy pair (or A center) in silicon.** Samara, G.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **36**: No. 9, 4841-4848(15 Sep 1987). Contract AC04-76DP00789.

A study of the pressure and temperature dependences of the electron thermal emission rate and capture cross section for the oxygen-vacancy (O-V) pair (or A center) deep level in n-type silicon is presented. The results allow characterization of the three important thermodynamic parameters, namely the Gibbs free energy, the enthalpy, and the entropy associated with electron emission from this level and their pressure dependences. Analysis of the results leads to the following highlights of the work. (1) There is a large breathing-mode lattice relaxation accompanying electron emission. The sign of this effect implies that the lattice relaxes inward (i.e., contracts) upon emission and outward (i.e., expands) upon capture. The sign is in agreement with the prediction of a model for the O-V pair defect based on EPR results but, as far as we know, the present results provide the first and only quantitative measure of this relaxation. (2) The energy of this level is not pinned to either the conduction- or valence-band edges. The level moves higher in the gap with pressure consistent with its expected antibonding character. (3) The electron-capture cross section is found to be essentially temperature and pressure independent. It is suggested that this result can be understood in terms of nonradiative electron capture by multiphonon emission.

45836 **Estimate of the barrier to and rate of dissociation of dense nitrogen under shock conditions.** Calef, D.F.; Ree, F.H. (University of California, Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* **36**: No. 9, 4935-4939(15 Sep 1987). Contract W-7405-ENG-48.

A simple method is introduced to estimate the barrier to dissociation of nitrogen under shock conditions. A free-energy curve is constructed from quantum-mechanical calculations of the ground-state potential well for N_2, the model exponential-six potential for the dissociated state, and the additional chemical potential (due to the surrounding dense media) in the hard-sphere approximation. The curves are adjusted to yield behavior in agreement with equilibrium thermodynamic calculations. The barriers are several electron volts, decreasing with pressure. Estimates for the prefactor in an Arrhenius rate expression are based on the recent computer simulations of nitrogen vibrational relaxation [B. Holian, J. Chem. Phys. 84, 3138 (1986)]. Time scales for reaction vary from microseconds to tenths of nanoseconds with increasing shock pressure.

45837 **Time-resolved x-ray scattering study of ordering kinetics in $SbCl_5$-intercalated graphite.** Hernandez, P.; Lamelas, F.; Clarke, R.; Dimon, P.; Sirota, E.B.; Sinha, S.K. (Department of Physics, The University of Michigan, Ann Arbor, Michigan 48109-1120). *Physical Review Letters;* **59**: No. 11, 1220-1223(14 Sep 1987).

The kinetics of ordering are studied in $SbCl_5$-intercalated graphite by utilization of x-ray synchrotron radiation and position sensitive detection. Analysis of the time-dependent scattering function (Lorentzian) confirms that the ordering obeys an algebraic growth law until defect pinning sets in. We obtain evidence for a novel kinetic phenomenon in which thermal roughening is suppressed in the unpinned state.

45838 **Critical behavior of hydrogen in Nb/Ta superlattices.** Miceli, P.F.; Zabel, H. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review Letters;* **59**: No. 11, 1224-1227(14 Sep 1987). Contract AC02-76ER01198.

We present an in situ x-ray scattering study showing the existence of the lattice-gas lattice-liquid phase transition for H dissolved in Nb/Ta superlattices where it is found that critical fluctuations with wavelengths shorter than the superlattice periodicity are suppressed. Since fluctuations of only long wavelengths develop, phase separation into gas and liquid phases cannot occur. These results demonstrate that the coherent phase transition is sensitive to the microscopic properties of the H-H interaction.

45839 **Liquid-to-vapor homogeneous nucleation in liquid nitrogen.** Sinha, D.N.; Brodie, L.C.; Semura, J.S. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 4082-4085(1 Sep 1987).

Experimental data on the liquid-to-vapor homogeneous-nucleation temperature, which provides a fundamental limit on the maximum attainable superheat, are presented for liquid nitrogen in the temperature range 77.4 K<T/sub s/<124.6 K, where T/sub s/ is the saturated bath temperature of liquid nitrogen. These data were obtained from a transient-heating experiment and are relevant to the design of superconducting systems using the recently discovered high-temperature superconductors and liquid nitrogen as the coolant.

45840 **Remanence on microscopic and macroscopic scales in the reentrant spin glass Eu/sub x/Sr/sub 1-//sub x/S.** Aeppli, G.; Maletta, H.; Shapiro, S.M.; Abernathy, D. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 3956-3959(1 Sep 1987).

We present a neutron scattering study of Eu/sub 0.54/Sr/sub 0.46/S in magnetic fields H≦60 mT. The Bragg intensity is history dependent in both the ferromagnetic (FM) and spin-glass (SG) regimes. The FM and SG regimes are distinct in that the spin fluctuations are history dependent only in the SG regime. The latter effect is very dramatic: cooling to 0.5 K in a 41-mT field and then setting H = 0 results in a magnetic correlation length of less than 65 A, well below the zero-field-cooled value of 140 A.

45841 **Solidification of highly undercooled liquid silicon produced by pulsed laser melting of ion-implanted amorphous silicon: Time-resolved and microstructural studies.** Lowndes, D.H.; Pennycook, S.J.; Jellison, G.E. Jr.; Withrow, S.P.; Mashburn, D.N. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Materials Research;* **2**: No. 5, 648-680(Sep 1987). Contract AC05-84OR21400.

Nanosecond resolution time-resolved visible (632.8 nm) and infrared (1152 nm) reflectivity measurements, together with structural and Z-contrast transmission electron microscope (TEM) imaging, have been used to study pulsed laser melting and subsequent solidification of thick (190—410 nm) amorphous (a) Si layers produced by ion implantation. Melting was initiated using a KrF (248 nm) excimer laser of relatively long [45 ns full width half maximum (FWHM)] pulse duration; the microstructural and time-resolved measurements cover the entire energy density (E/sub l/) range from the onset of melting (at approx. >0.12 J/cm²) up to the onset of epitaxial regrowth (at —1.1 J/cm²). At low E/sub l/ the infrared reflectivity measurements were used to determine the time of formation, the velocity, and the final depth of "explosively" propagating buried liquid layers in 410 nm thick a-Si specimens that had been uniformly implanted with Si, Ge, or Cu over their upper — 300 nm. Measured velocities lie in the 8—14 m/s range, with generally higher velocities obtained for the Ge- and Cu-implanted "a-Si alloys." The velocity measurements result in an upper limit of 17 (+- 3) K on the undercooling versus velocity relationship for an undercooled solidfying liquid—crystalline Si interface. The Z-contrast scanning TEM measurements of the final buried layer depth were in excellent agreement with the optical measurements.

45842 **In situ optical and structural studies of H_2 chemisorption in C_8K.** Doll, G.L.; Eklund, P.C. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). *Journal of Materials Research;* **2**: No. 5, 638-644(Sep 1987).

Results of in situ optical (reflectance, Raman scattering) and 00l x-ray diffraction studies of hydrogen chemisorption in Grafoil-based stage 1 C_8K intercalation compounds are presented. Upon hydrogen uptake, stage 2 KC_8H_2/sub //$_3$ was found to coexist with C_8K forming first in the optical skin depth. The intensities of the 00l x-ray diffraction peaks show quantitatively that the reaction $C_8K + 1/2\ xH_2 \rightarrow (1- (3)/(2)\ x)C_8K + (3)/(2)\ xC_8KH_2$/sub //$_3$ occurs for x≧0.4 in the bulk. The effects of the surface morphology of Grafoil on the near-normal incidence reflectance was investigated and found to be described by an energy (E) dependent function S(E) = exp[-αE/sup n/], such that the corrected spectrum R/sup c/ = SR, where R is the Grafoil reflectance. In this manner, reflectance spectra of C_8K-Grafoil and C_8KH_2/sub //$_3$-Grafoil were quantitatively analyzed to determine the free carrier contribution. The free carrier lifetimes were found to be a factor of 2 shorter in Grafoil-based hosts, compared to highly oriented pyrolytic graphite-based hosts. The optical results for C_8KH_2/sub //$_3$ indicate the H(1s) band is full (or very nearly full).

45843 **Pasternak, Farrell, and Taylor reply.** Pasternak, M.; Farrell, J.N.; Taylor, R.D. (Tel Aviv University, Ramat Aviv 69978, Israel). *Physical Review Letters;* **59**: No. 8, 945-945(24 Aug 1987).

A reply to the comment on metallization and structural transformation of iodine under pressure is presented. (AIP)

45844 **Comment on "Diffusion without vacancies or interstitials: A new concerted exchange mechanism".** Dienes, G.J.; Welch, D.O. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **59**: No. 7, 843-843(17 Aug 1987). Contract AC02-76CH00016.

A Comment on the Letter by K. C. Pandey, Phys. Rev. Lett. 57, 2287 (1986).

45845 **Renormalized acoustic branch in the vibrational spectrum of the π-bonded—chain model of Si(111)21.** Alerhand, O.L.; Mele, E.J. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review Letters;* **59**: No. 6, 657-660(10 Aug 1987).

We calculate the low-frequency phonon spectrum of the π-bonded—chain model of the Si(111)2 x 1 surface, and find an explanation for the surprising observation, in He-atom scattering experiments, of a low-energy dispersionless surface phonon. This feature results from strong electron polarization effects, which arise from the quasi one-dimensional nature of the π-bonded—chain model. The assignment of this mode as an Einstein oscillator is incorrect. Our calculations are based on Chadi's tight-binding theory for structural energies, with the addition of a Hubbard interaction.

45846 **Process for the chemical preparation of high-field ZNO varistors.** Brooks, R.A.; Dosch, R.G.; Tuttle, B.A. (to Dept. of Energy, Washington, DC). US Patent 4,681,717. 21 Jul 1987. Filed date 19 Feb 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a process for the production of a varistor precursor by intimate mixing of zinc oxide, bismuth oxide, and at least one additional metal oxide dopant, the improvement comprising: mixing the oxides by (a) precipitating zinc or coprecipitating zinc and at least one additional metal from a solution of chloride salts by means of an inorganic hydroxide, (b) converting the precipitate to oxides by calcining at 400-600 degrees C, and (c) precipitating bismuth on the surface of the oxides by contacting with a solution of Bi dissolved in HNO/sub 3/; the additional oxide dopant is MnO, CoO, or a mixture thereof, and where the proportions of oxides in the resulting precursor are about: 93-98.5 mole% Zn, 0-1.0 mole% Co, 0-1.2 mole% Mn, 0.1-6.0 mole% Bi.

45847 **Radiation growth study of acoustic loss related defects in alpha-quartz.** Hwang, H.W.; Martin, J.J. (Oklahoma State Univ., Stillwater). *Applied Physics Communications;* 7: No. 1-2, 118(Mar-Jun 1987).

As-grown cultured quartz contains substitutional Al which is charge compensated by an interstitial alkali. Irradiation at temperatures above 200 K replaces the alkali with either a hole or a proton forming the Al-hole and Al-OH centers. The Al-Na center has a strong acoustic loss peak at 53 K for 5MHz crystals. The irradiation reduces this peak and produces loss peaks at 100 K and at 23 K. The 100 K peak is associated with the Al-hole center. They report production studies of the defects producing these acoustic loss peaks. The Al-Na center goes out as the sum of two exponential decay terms. The Al-hole (100 K peak) grows in at a faster rate than the defect responsible for the 23 K peak. Subsequent irradiation at 90 K increases the 100 K Al-hole center peak but causes only a small growth of the 23 K peak. These results suggest that the 23 K peak defect is not directly related to the Al-hole center.

45848 **High damage threshold optical coatings.** Milam, D. (Lawrence Livermore National Lab., Livermore, CA). pp 40-47 of Topical meeting on optics in adverse environments (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—). Contract W-7405-ENG-48.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

Projects at Lawrence Livermore National Laboratory require optical coatings capable of withstanding fluences of 8-10 J/cm/sup 2/ delivered in single laser pulses with durations of 1-3 ns, or in repeated irradiations, at rates exceeding 100 Hz, by pulses with durations of 10-50 ns. Future fusion lasers require coatings with higher thresholds. To develop these coatings, a program maintains evaluating sol-gel coatings deposited from solutions, single-layer films made by chemical vapor deposition (CVD) and coatings made by conventional physical vapor deposition (PVD). Porous sol-gel AR coatings are the only optical films known to satisfy all current threshold requirements. The median, single-pulse, 1064-nm thresholds of these coatings range from 11 J/cm/sup 2/ at 1-ns to 33 J/cm/sup 2/ at 9 ns. They survive 100 Hz irradiation by 16-ns, 1064-nm pulses at fluences above 20 J/cm/sup 2/, have thresholds above 15J/cm/sup 2/ when tested at 100 Hz with 25-ns, 350-nm pulses. This study found that thick (500-800 nm) silica coatings made by stacking 5 to 10 thin solution-deposited layers reduce thresholds at 351-nm, and that subjecting a thick layer to an ozone treatment usually improves its threshold.

45849 **Porous halide antireflective coatings for adverse environments.** Thomas, I.M. (Lawrence Livermore National Lab., Livermore, CA). pp 49-51 of Topical meeting on optics in adverse environments (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—). Contract W-7405-ENG-48.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

This study finds that many metal fluorides are stable in adverse environments and some are used as coatings for optical components. In general, these materials have low refractive indices and are therefore of use as the low index component in multilayer AR or HR coatings or, in some cases, notably MgF/sub 2/, as the single component in simple 1/4 wave AR coatings. These coatings are normally prepared by evaporation or sputtering and as such are substantially dense and therefore of an index close to that of the bulk fluoride material. This is quite satisfactory for multi-layer application but is inefficient in 1/4 wave AR coatings on typical substrates of index about 1.5 because the index is too high.

45850 **Charge and polarization relaxation in thermoelectrets.** Puri, O.P.; Sinha, O.; Harrington, T.; Bota, K.B. (Dept. of Physics, Clark College, Atlanta, Georgia 30314). pp 134-138 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

A theory has been developed for the formation and decay of thermoelectrets. The basic ideas are: alignment of interacting dipoles, trapping of homocharge by the frozen aligned dipoles and a nonlinear theory of relaxation process consistent with the statistical thermodynamics of condensed material. A formula has been developed which can be used to qualitatively explain different types of thermoelectrets formed with different materials under different conditions and semiquantitatively explain their decay and thermally stimulated discharge process.

40 CHEMISTRY

45851 **(CSIR-SR-CHEM—269) Annual report 1986 [from National Chemical Research Lab., South Africa].** (Council for Scientific and Industrial Research, Pretoria (South Africa). National Chemical Research Lab.). 1986. 125p. National Chemical Research Laboratory, CSIR, Box 395, Pretoria, 0001, South Africa.

This report covers research achievements of the Laboratory during 1986. A method has been developed for the separation of ultra-trace amounts of lead from gram amounts of elements such as bismuth, tin, indium, and cadmium by cation-exchange chromatography. An improved procedure for separating indium-111 from cyclotron irradiated silver targets, using cation exchange chromatography and a low crosslinked resin, provides material of superior purity for blood platelet studies. The discovery of efficient synthetic routes to cyclopentadiene complexes of ruthenium and osmium provides scope for possible commercial exploitation, and the use of ruthenium metallo cyclopentatriene intermediate in the conversion of acetylenes and alkyl-cyanides into substituted pyridines holds promise for the preparation of a variety of industrially useful chemicals. The incorporation of /sup 18/0 labelled precursors into a group of structurally related mycotoxins, citreoviridin, asteltoxin, and aurovertin B, was studied with the aid of isotope shift effects upon /sup 13/ C NMR, and has contributed to mechanistic and stereochemical knowledge about the biogenesis of these important metabolites.

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 44880, 45039, 45041, 45056, 45057, 45118, 45199, 45936, 45938, 45939, 45942, 45953, 46102, 46190, 46708

45852 **(CONF-870802—10) Application of continuous annular chromatography to size-exclusion separations.** Sisson, W.G.; Begovich, J.M.; Byers, C.H.; Scott, C.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014406.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Continuous multicomponent liquid chromatographic separations have been achieved by using a slowly rotating annular bed of sorbent material. Feed is continuously introduced at a stationary point at the top of the bed while eluent flows over the remainder of the annulus. The rotation of the sorbent bed coupled with the simultaneous elution chromatography causes the separated components of the feed streams to appear as helical bands, each of which has a characteristic, stationary exit point. The concept has been developed using continuous annular chromatography units ranging from 50 to 450 mm in diameter and operating between 7 and 1300 kPa. To illustrate size-exclusion chromatography on a continuous basis, the separation of a polysaccharide, Blue Dextran, and a much smaller molecule, $CoCl_2$, on Sephadex G15, was studied over a wide range of feed rates, feed concentrations, rotation rates, and eluent velocities. Plate theory, modified for application to continuous chromatography, provided an excellent means of modeling the experimental results.

45853 **(DOE/ER/13552—1) Simulation and optimization of three-phase distillation processes.** Kingsley, J.P.; Lucia, A. (Clarkson Univ., Potsdam, NY (USA). Dept. of Chemical Engineering). Mar 1987. Contract FG02-86ER13552. 56p. (CONF-870323—6). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014008.

From American Institute of Chemical Engineers spring national meeting; Houston, TX, USA (29 Mar 1987).

The geometry of vapor-liquid (VL) and vapor-liquid-liquid (VLL) solutions to simulation and optimization problems for heterogeneous flash and distillation processes is studied. Particular emphasis is placed on the relationship between VL and VLL solutions to the same problem and any associated algorithmic implications. Solution curve approximations are used to build an accurate and inexpensive global picture of the various solutions to flash problems and, when needed, to aid the problem solving tasks. The essential solution geometry for homogeneous and heterogeneous solutions to three-phase distillations is captured using a projected 2-surface in R^3. Steep fronts, regular turning points and bifurcation points are shown in the homogeneous solution manifold. Paths from multiple homogeneous solutions to the heterogeneous solution to the same problem are also studied as well as the structure of various heterogeneous solution manifolds. The level sets of an objective function on a projected 2-surface in R^3 are used to study the optimization of heterogeneous distillations. Specific attention is focused on the existence of local optima and their effect on both active set and line searching strategies. 24 refs., 14 figs., 7 tabs.

45854 **(DOE/HWP—34) Bench-scale magnetic separation of Department of Energy wastes.** Hoegler, J.M. (Oak Ridge National Lab., TN (USA). Hazwrap Support Contractor Office). Jul 1987. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013375.

Criteria were developed for selection of candidate wastes for testing magnetic separation of uranium and/or other paramagnetic materials. A survey of Department of Energy (DOE) hazardous wastes was conducted to determine good candidates for bench-scale magnetic separation tests. Representatives of 21 DOE sites were contacted, and 11 materials were identified as potential candidates for magnetic separation. To date, seven samples have been obtained and tested for separability of uranium with a bench-scale magnetic assaying device. The samples tested have been obtained from the K-1401B and K-1401C ponds in Oak Ridge, Tennessee; from waste piles in Maywood, New Jersey; from North and South Ponds in Richland, Washington; and from magnesium fluoride drums in Fernald, Ohio. The magnetic device utilized in these tests can be used in an open-gradient mode with dry particulate or liquid-suspended materials. Uranium separation from magnesium fluoride has shown exceptionally good performance in both open- and high-gradient modes and could be an important application of the technology.

45855 **(INIS-mf—10935) Quantitative electron probe microanalysis of boron in binary borides.** Bastin, G.F.; Heijligers, H.J.M. (Technische Hogeschool Eindhoven (Netherlands). Lab. voor Fysische Chemie). 1 Mar 1986. 118p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87703104.

Quantitative electron probe microanalysis has been performed in 27 binary borides in the range of 4-30 keV, both for the metals as well as for Boron. The procedures along which accurate intensity measurements for B-K/sub α/ must be carried out are discussed in detail. A total of 196 k-ratios with respect to elemental standards for the metal X-ray lines and 180 k-ratios for B-K/sub α/ relative to elemental Boron have been obtained. These data have been used to arrive at an improved parameterization for the phi(rhoz) approach in matrix correction. The resulting new program (BAS861) was compared to 5 other current correction programs. At the same occasion the available set of mass absorption coefficients for Boron was tested on its consistency and better values suggested where necessary. Finally it is shown that the modified version of the Gaussian phi(rhoz) approach (BAS861 program) is highly successful in the matrix correction for B-K/sub α/: a relative root-mean-square value of 6.30% was obtained. (Auth.). 15 refs.; 21 figs.; 11 tabs.

45856 (INIS-mf—10946, pp 54-59) **Computerized liquid scintillation assay of tritiated water and wipe test samples with a three-channel beta spectrometer.** Levinson, S.; Ben-Shachar, B.; Messing, M.; Carmon, B. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

45857 **(IS-T—1256) Determination of inorganic sulfur species in alkaline solutions using high performance liquid chromatography with polarographic detection.** Uddin, Z. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87013603.

The method for the simultaneous determination of various anionic sulfur species in the present research is based on the limiting polarographic currents for the sulfur compounds. The compounds present in a mixture are separated by liquid chromatography and are detected in a flow-through amperometric detector based on reactions at a dropping mercury electrode. The electrochemical detection of analytes after separation by liquid chromatography is commonly termed Liquid Chromatography with Electrochemical Detection (LCEC). No pre-treatment of alkaline sample solutions is required except dilution. The separated sulfur species are detected directly by the polarographic electrode without prior chemical conversion. The method was tested successfully for the determination of sulfide, sulfite, and thiosulfate in samples derived from the caustic desulfurization of coal. The maximum number of sulfur atoms in the polysulfide anion was determined ₀o be 5. Its polarographic curve has characteristic anodic and cathodic curves.

45858 (KURRI-TR—277, pp 28-34) **Nuclear constants of (n, γ)-produced nuclides in activation analysis.** Koyama, Mutsuo. (Kyoto Univ., Kumatori, Osaka, Japan. Research Reactor Inst.). Apr 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780156. (CONF-8602137—).

From 2. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (4 Feb 1986).

This report outlines the activation analysis method currently used in the Research Reactor Institute, Kyoto University, Japan, and discusses its advantages and disadvantages. Consideration is

also made on atoms which are likely to form volatile compounds in a radiation field. In particular, the principle of the multiple comparator method is described and a procedure is presented to determine various nuclear constants and the neutron spectrum of an irradiated rabbit. Then radiation experiments are performed and results obtained are described. In the case of rare earth elements, /sup 153/Gd, /sup 170/Tm, /sup 171/Er, /sup 175/Yb and /sup 46/Sc show large differences between the quantities determined and those actually added. For each of these, significant differences do not observed between quantitative determination values even when irradiation is performed in facilities with greatly different neutron spectra or when the cooling time is varried, indicating that there is a problem with nuclear constants which are acting like proportionality factors, namely, thermal neutron cross section and γ-ray emission probability. For /sup 169/Yb and /sup 175/Yb, there is also a problem with data of thermal neutron cross section and/or γ-ray emission probability. The problem, however, can be solved by determining accurately the γ-ray emission probability. (Nogami, K.).

45859 (SAAS—344, pp 44-50) **Emanation measurements of materials used in housing building.** Shalak, N.I.; Koroleva, N.A.; Krisyuk, Eh.M.; Lehmann, P. 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780163. (CONF-8509389—Pt.4).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

The emanation coefficients of building materials used in the USSR has been determined in order to assess their significance as radon sources in dwellings. The radon measurements were performed by sampling of 1 cm^3 of different building materials and by analysing the samples with a SAS-R-2 radonometer. The lowest values were found in materials being treated at elevated temperatures such as bricks and cements.

45860 (ZfI-Mitt—122, pp 163-175) **Mathematical description of properties of a weakly deformed Gauss peak. 2. Calculation of the modified correlation function of two weakly deformed Gauss peaks.** Braune, M. Nov 1986. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

The calculation of the modified correlation function of two weakly deformed Gaussian peaks can be done by closed integrations using the Gaussian error integral. The application of the modified correlation function and spectral techniques in connection with multi-channel analyzer and microcomputer allows the examination of the changed shape of measured peaks, if the multi-channel spectrum of one standard peak is stored.

45861 (ZfI-Mitt—122, pp 149-162) **Mathematical description of properties of a weakly deformed Gauss peak. 1. Calculation of the moment generating function and the higher moments.** Braune, M. Nov 1986. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

The properties of the weakly deformed Gaussian peak are described by given formulas. The moment generating function and all the higher moments of this weakly deformed Gaussian peak density function are calculated by closed integrations. The density function is useful for the design of Maximum-Likelihood peak shape parameter estimators and the application of spectral techniques with multi-channel spectra. Numerical calculations use the well known Gaussian error integral and can be done by programmable microcomputers or programmable pocket calculators.

45862 **Simultaneous determination of selenite and trimethylselenonium ions in urine by anion exchange chromatography and molecular neutron activation analysis.** Blotcky, A.J.; Hansen, G.T.; Borkar, N.; Ebrahim, A.; Rack, E.P. (Veterans Administration Medical Center, Omaha, NE). *Analytical Chemistry;* **59**: No. 17, 2063-2066(1 Sep 1987). Contract FG02-84ER13231.

A method has been developed for the determination of trimethylselenonium (TMSe) ion and selenite (SeO_3^{2-}) ion in urine by anion exchange chromatography, selectively eluting TMSe and SeO_3^{2-}. Since the recoveries are quantitative, a method of additive spikes is employed to determine TMSe and SeO_3^{2-} ion concentrations in urine specimens. The TMSe and SeO_3^{2-} chromatographic elutions were collected in vials, irradiated with neutrons, and radioassayed for /sup 77m/Se activity. The limit of detection is 10 ng of Se as TMSe or SeO_3^{2-}/ml of urine. Thirteen urine specimens from normal subjects were analyzed for TMSe, SeO_3^{2-}, and total selenium concentration.

45863 **Separation of metal-containing compounds by supercritical fluid chromatography.** Ashraf-Khorassani, M.; Hellgeth, J.W.; Taylor, L.T. (Virginia Polytechnic Institute and State Univ., Blacksburg). *Analytical Chemistry;* **59**: No. 17, 2077-2081(1 Sep 1987). Contract FG22-84PC70799.

Supercritical fluid chromatography using packed, analytical-scale chromatographic columns was applied to gain separations of several metal-containing systems. Mixtures of substituted ferrocenes and metal β-diketonates were separated by using methanol-modified CO_2 under moderate temperatures (50-100°C) and pressures (2000-5000 psi) as the mobile phase. Two different types of chromatographic behaviors were observed which were found to be dependent on whether the separated metallic species was either substitutionally inert or substitutionally labile. For inert species, proper chromatographic behavior indicative of a reversible adsorption mechanism was found. For labile species, retention time variation with injected amount, appearance of broad component peaks, and observation of multiple species for a single injection gave indication of irreversible adsorptive mechanism.

45864 **Surface-enhanced Raman spectrometry of organophosphorus chemical agents.** Alak, A.M.; Vo-Dinh, T. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **59**: No. 17, 2149-2153(1 Sep 1987). Contract AC05-84OR21400.

Organophosphorus chemical agents have been analyzed by surface-enhanced Raman scattering (SERS) spectrometry. Significant spectral enhancement was achieved with special substrates that were prepared with silver-coated microspheres. Organophosphorus compounds were easily and rapidly measured at nanogram levels. The SERS spectra of eight of these organophosphorus chemical agents are presented. The sensitivity and spectral selectivity of this new spectrochemical technique for trace organic analysis of toxic chemical agents are discussed. Analyses of a two-component mixture and contaminated soil sample extract are illustrated.

45865 **Detection of single molecules of phycoerythrin in hydrodynamically focused flows by laser-induced fluorescence.** Nguyen, D.C.; Keller, R.A.; Jett, J.H.; Martin, J.C. (Los Alamos National Lab., NM). *Analytical Chemistry;* **59**: No. 17, 2158-2161(1 Sep 1987).

Single molecules of B-phycoerythrin were detected by laser-induced fluorescence in hydrodynamically focused flows as each molecule transited a focused laser beam. Phycoerythrin is a large protein molecule containing the equivalent of 25 rhodamine-6G chromophores. Single molecule detection is documented by the following: (1) the number of counts per molecule is in agreement with the expected number, (2) the number of molecules per second is in agreement with the concentration and the flow rate, and (3) the time interval distribution between detected molecules is in agreement with the concentration and the flow rate. The molecular transit time through the 1.1-pL probe volume was 180 μs.

45866 **Low-pressure laser spectroscopy with flame atomization.** Whitten, W.B.; Koutny, L.B.; Nolan, T.G.; Ramsey, J.M. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **59**: No. 17, 2203-2206(1 Sep 1987). Contract AC05-84OR21400.

The authors have developed a low-pressure interface that permits high-resolution laser spectroscopy to be performed with an air-acetylene analytical burner. The reduced pressure in the measuring cell effectively eliminates collision broadening so that laser techniques for Doppler-free spectroscopy can be fully exploited. The interface has been tested with a form of saturation spectroscopy. Spectral resolution of 50 MHz has been demonstrated for sodium.

45867 **Laser-enhanced flame ionization detector.** Cool, T.A.; Goldsmith, J.E.M. (Cornell University, School of Applied & Engineering Physics, Ithaca, New York 14853). *Applied Optics;* **26**: No. 17, 3542-3551(1 Sep 1987).

A laser-enhanced flame ionization detector is proposed which promises to retain the desirable properties of conventional flame ionization detectors while providing significantly lower detection limits. Experiments are described which demonstrate laser enhancement of the flame ionization detector response. Realization of the full potential sensitivity of the laser-enhanced flame ionization detector requires significant modifications to permit effective saturation of the laser absorption over a major fraction of the flame ionization zone.

45868 **Photochemical effects in two-photon-excited fluorescence detection of atomic oxygen in flames.** Goldsmith, J.E.M. (Sandia National Laboratories, Combustion Research Facility, Livermore, California 94550). *Applied Optics;* **26**: No. 17, 3566-3572(1 Sep 1987).

This paper describes photochemical effects observed using 226-nm two-photon-excited fluorescence detection to measure the atomic oxygen concentration in hydrogen-oxygen flames. In a study of a lean atmospheric-pressure flame, we observed artificially high atomic-oxygen concentration levels in the postflame gases using all but the most gentle excitation conditions (intensities greater than —0.1 GW/cm^2). A similar study of a lean low-pressure (72-Torr) flame showed little evidence of photochemical production of atomic oxygen. Using a second laser system in a pump-probe configuration, with the probe laser monitoring the atomic oxygen concentration in a very lean flame while the pump laser was scanned across molecular-oxygen Schumann-Runge bands at 221 nm, we demonstrated that excess atomic oxygen concentration can be produced by single-photon excitation of these bands in vibrationally excited oxygen molecules present in the flame. This production mechanism explains at least part of the artificially high concentration levels observed in the atmospheric-pressure flame.

45869 **Double optical resonance mass selective detection of aromatic molecules in a supersonic molecular beam.** Syage, J.A.; Wessel, J.E. (Aerospace Corporation, P.O. Box 92957, Los Angeles, California 90009). *Applied Optics;* **26**: No. 17, 3573-3578(1 Sep 1987).

Optical excitation followed by ion mass detection in a supersonic molecular beam can offer unusually high levels of selectivity for detection of trace concentrations of material in the atmosphere. We describe recent work involving two-color excitation of aromatic molecules in a supersonic molecular beam, time-of-flight mass spectrometer. It is shown how double resonance excitation in cold molecules can provide two very selective stages of optical selectivity, further augmented by single mass detection. Three applications are described: (1) Two-color excitation to higher excited electronic states is illustrated for final states above and below the ionization potential. (2) Stimulated emission pumping is shown to allow selective identification using ion dip detection. (3) Resonance ion dissociation is demonstrated as a means for obtaining double optical and double mass selectivity.

45870 **Evaluation of laser desorbed transition-metal ions as analytical chemical ionization reagents by pattern recognition.** Forbes, R.A.; Tews, E.C.; Huang, Y.; Freiser, B.S.; Perone, S.P. (Purdue Univ., West Lafayette, IN). *Analytical Chemistry;* **59**: No. 15, 1937-1944(1 Aug 1987). Contract AC02-80ER10689.

Ten transition-metal ions are evaluated as chemical ionization reagents by use of pattern recognition. The data for the reactions of Sc^+, Y^+, La^+, V^+, Nb^+, Ta^+, Cr^+, Fe^+, Co^+, and Cu^+ with 11 ketones, 8 aldehydes, and 8 ethers were collected with a Fourier transform mass spectrometer equipped with a laser desorption ionization source. Selectivities of the metal ions for the three organic classes are quantitated and compared to 70-eV electron impact (EI) data. While a 100% recognition accuracy for the three classes is obtained for EI, Cu^+, and Sc^+ data, the fewest features are required for, and the best separation is produced with, the Sc^+ data. The selected features are also examined for their chemical information, providing clues to the characteristic reactivities and reaction mechanisms for the metal ions with three functional groups.

45871 **High sensitivity optical detection methods in hydroxide eluent suppressed anion chromatography via post suppression ion exchange.** Shintani, H.; Dasgupta, P.K. (Texas Tech Univ., Lubbock). *Analytical Chemistry;* **59**: No. 15, 1963-1969(1 Aug 1987). Contract FG05-84ER13281.

Detection by post suppression ion exchange, as an adjunct to suppressed hydroxide eluent ion chromatography, involves exchange of eluting sample anion or concurrently present H^+ for a fluorescent/optically absorbing anion or cation such as anthranilate or Ce^{3+}. Membrane-based post suppression devices permit reliable continuous operation, and detection limits can be better than those attainable by conductivity detection. The anion exchange membrane-anthranilate system also yields excellent detection limits by UV absorption except that membrane degradation is a problem. The ion exchange at the membrane interface is not an equilibrium process. The dependence of the membrane response on an external high frequency electrical field suggests that the transport of the ions through the membrane is not a rate-determining factor.

45872 **Reverse micelle supercritical fluid chromatography.** Gale, R.W.; Fulton, J.L.; Smith, R.D. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* **59**: No. 15, 1977-1979(1 Aug 1987). Contract AC06-76RL01830.

Reverse micelles in supercritical fluids may be used to replace more polar mobile phases for normal-phase chromatography with silica columns. Both liquid and supercritical propane reverse micelle mobile phases have been investigated at ambient and elevated temperatures and shown to provide a large decrease in retention for polar compounds compared to pure propane. The decreased efficiency due to mass transport limitations for liquid reverse micelle phases can be alleviated by operating at higher temperatures. Use of a reverse micelle containing supercritical fluid solvent further increases efficiency over reverse micelle liquid mobile phases.

45873 **Apparatus for direct counting of beta-rays from two-dimensional protein gels: measurement of changes in protein synthesis due to changes in density of Chinese hamster ovary cells.** Anderson, H.L.; Puck, T.T.; Shera, E.B. (Los Alamos National Lab., NM). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 14, 4749-4753(Jul 1987).

A method is described for scanning two-dimensional protein gels that utilizes direct counting of beta-rays instead of autoradiography. The methodology is compared with autoradiographic results and data are presented demonstrating changed patterns of protein synthesis accompanying changes in cell density. The method is rapid and permits identification of differences in protein abundance of approximately 10% for a substantial fraction of the more prominent proteins. A modulation effect of greater than 5 standard deviations is shown to occur for an appreciable number of the proteins that accompany the inhibition of cell growth due to contact inhibition. The method promises application to a variety of biochemical and genetic problems designed to delineate changes in protein synthesis accompanying changes in genome, molecular environment, history, and state of differentiation of the cell populations studied.

45874 **The role of neutrons in safeguards.** Menlove, H.O. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 83-87(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

Both passive- and active-neutron-based nondestructive assay (NDA) systems have been used extensively for safeguards, process control, and criticality safety. Most plutonium measurements make use of the passive neutron signal from the spontaneous fission of the /sup 240/Pu-effective; however, uranium samples often require active neutron assay because the passive signals are too weak or lacking in penetrability. This paper gives a brief review of active and passive neutron NDA systems. Some future directions for the passive assay of plutonium are discussed.

45875 **The development of gamma-ray spectrometry for safeguards.** Parker, J.L. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 4, 88-92(Jul 1987). (CONF-870381—).

From Symposium on safeguards at Los Alamos: 20 years; Los Alamos, NM, USA (5 Mar 1987).

The development of gamma-ray spectrometry for safeguards applications has progressed steadily during the past 20 years and such methods for nondestructive assay (NDA) of special nuclear materials (SNW) are now reasonably mature. With a few significant exceptions the more important procedures now in use fall into five general areas. The development and current status of methods in those general areas are discussed separately. Problems remaining in more effectively using gamma-ray NDA in safeguards, along with probable advances in method and improvements in equipment are also briefly discussed.

45876 **EXAFS spectroelectrochemistry of coordination complexes in non-aqueous solutions.** Dewald, H.D.; Heineman, W.R.; Elder, R.C. (Ohio Univ., Athens). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Advances in the development of synchrotron radiation as source of high x-ray photon flux for absorption spectroscopy and a reinterpretation of the extended x-ray absorption fine structure (EXAFS) phenomenon have made structural studies of materials in solution relatively straightforward. Efforts to extend the technique to study materials in nonaqueous solution are reported. One system investigated is trans- $[Re(DEPE)_2Cl_2]$ PF_6, (where DEPE represents 1,3-bis(diethylphosphino)ethane). The bis(phosphine)ligands are known to stabilize technetium in several oxidation states; cationic complexes of /sup 99m/Tc are of interest as myocardial imaging agents. EXAFS spectra on the solid complex and on the solution species have been measured. The Fourier transform exhibits one main peak for both the Re-P and Re-Cl interactions. A distance of 2.44 A for Re-P and 2.35 A for Re-Cl has been obtained. The complex $[W_2(CO)_8(S\text{-}Benzyl)_2]$ $[Et_4N]_2$ has been investigated. The interest in thiolate complexes of tungsten and molybdenum is related to their possible implication in the structure and function of molybdoenzymes.

45877 **ESR studies of charge-transfer in coal-derived liquids.** Retcofsky, H.L.; Sprecher, R.F.; Hough, M.R.; Castellano, S.M.; Maguire, M.M. (Dept. of Energy, Pittsburgh, PA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Hydrogen bonding, van der Walls, and charge-transfer interactions have all been proposed as possible bonding forces in coal-derived liquids as well as in coals themselves. Considerable controversy, however, exists over the importance (or lack of importance) of charge-transfer interactions in these materials. As part of a study into the role of intermolecular interactions in the structure of coal and coal-derived liquids, variable temperature ESR studies of coals, coal-derived liquids, functionality-enriched fractions of coal-derived liquids, and functionality-enriched fractions treated with pure compounds were conducted. The results of this investigation were interpreted on the basis of the ESR behavior that is commonly exhibited by known charge-transfer complexes. In the case of the coal-derived liquids all samples were found to obey the Curie Law; the same temperature behavior was observed for functionality-enriched fractions of the liquids. Additionally, the ESR intensity of the coal-derived liquid at each temperature was approximately equal to the weighted sum of those of the separated components. Both observations are consistent with the view that charge-transfer complexes are relatively unimportant in coal liquids.

45878 **Use of a computer controlled flow injection analysis system for the rapid on-line determination of distribution coefficients.** Nekimken, H.L. (Los Alamos National Lab., NM). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

A search for simpler and more effective ways to perform various actinide and lanthanide separations is in progress. Emphasis has been on evaluating ligands for their ability to complex and extract metal ions under a variety of experimental conditions. To evaluate effectively these extractants and to ultimately correlate structural features with extraction capabilities, a large volume of distribution coefficient (Kd) data must be acquired. Kd data for each ligand should be obtained as a function of such variables as ligand and metal ion concentration, pH, and organic solvent employed. Unfortunately, batch Kd experiments are generally time consuming and tedious. A computer controlled flow injection analysis system has been developed to obtain rapid on-line Kd data. A diluter/dispenser is utilized to generate the various aqueous metal ion samples. Results indicate this FIA system can be used to effectively determine Kd values for certain chemical systems. The FIA apparatus should also be useful for other applications that require on-line extraction and/or detection (or kinetics studies). Reasonably good agreement has been obtained between batch and FIA Kd values for the extraction of Pb(II), Zn(II) and Cd(II) by dithizone. Fe(III) by 1-phenyl-3-methyl-4-benzoyl-pyrazolone-5 (PMBP) and uranyl by the 5-thione derivative of BMBP (SPMBP). A study of the uranyl-SPBMP chemical system with FIA is now nearing completion.

45879 **Degenerate four-wave mixing in an analytical flame.** Ramsey, J.M.; Whitten, W.B.; Nolan, T.G. (Oak Ridge National Lab., TN). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—). Contract AC05-84OR21400.

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Degenerate four-wave mixing or DFWM spectroscopy is a coherent optical process where three input beams of identical frequency (degenerate) are coupled together by a resonance enhanced nonlinearity to generate a fourth output beam. The spectra observed by DFWM are theoretically background free, i.e., no signal is observed when no sample is present. This feature has obvious advantages for detecting trace quantities of materials. In addition, the Doppler-free nature of DFWM measurements provides spectral resolution superior to conventional techniques, improving the selectivity of the measurements. Experiments have been performed employing a pulsed Nd-YAG pumped dye laser where sodium is the test analyte. A combination of spatial filtering, depolarization selection, and temporal resolution are used to selectively discriminate against background signals. This experimental setup resulted in a detection limit of 4 ppb sodium in aqueous solution. Improved results are expected with CW lasers because of the 10^8 higher duty cycle and the relatively low intensities required to saturate allowed atomic transitions. Preliminary results using a single-frequency CW dye laser will also be reported.

45880 **Dual cell FTMS-A powerful tool for complex mixture analysis.** Wise, M.B.; Buchanan, M.V. (Oak Ridge National Lab., TN). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Fourier transform mass spectrometry (FTMS) is a unique and highly versatile analytical technique. Many of the features of FTMS including ultra-high mass resolution (>2,000,000 at m/z 100), wide mass range (>5000 amu), exact mass measurement capability, selective low pressure chemical ionization, and collision in-

duced dissociation (CID) mass spectrometry/mass spectrometry (MS/MS) are ideally suited for the analysis of complex mixtures such as fuel related samples and tobacco smoke tars. FTMS is also being used as a tool for the study of tobacco smoke samples. Smoke tar, which is a mixture of thousands of compounds, was collected on a fiberglass filter pad, extracted with solvent, and deposited on the tip of the heated direct insertion probe. Low ionization potentials were used to form predominantly molecular ions, providing a separation of the smoke tar constituents on the basis of molecular weight. A temperature ramping program was used to distill the sample off of the probe and 25 spectra were collected at each temperature level. Using a bandwidth of 1 MHz and collecting 256K data points, mass resolution of 30,000 FWHM was obtained at m/z 100. This was sufficient to resolve numerous isobaric ions and calculate empirical molecular formulas of the ions from their exact masses.

45881 **Improved quantitative spectroscopy by combining least squares methods with principal components analysis.** Ward, K.J. (Sandia National Labs., Albuquerque, NM). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Full spectrum classical least squares methods have long been used for quantitative spectroscopic analyses. They have an advantage over other quantitative techniques in that chemical information is available from the pure component spectra calculated in the calibration phase and from the residual spectra generated during the prediction phase of the analysis. The presence of Beer's law nonlinearities or unexpected components have previously been accounted for by pooling results from fits for individual peaks, as well as by iterative weighting based upon the variance at each frequency. Although results are greatly improved, these adaptations still do not provide for modeling of the spectral contributions due to either of these problems. Principal components analysis (PCA) applied to the residual spectra from the calibration phase will perform this modeling. Thus, PCA can be used to identify factors which account for model errors in the calibration. By using cross validation the contributions of factors to the residual spectrum other than the noise can be evaluated, and may also be chemically interpreted since this is a full spectrum method. Examples of the technique for both synthetic data and for FTIR spectra of borate sol-gels will be presented and compared to results derived from numerous other least squares methods.

45882 **Fiber optic sensor engineering: no trivial matter.** Miller, H.H. (Lawrence Livermore National Lab., CA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Over the past decade, the scientific community has become increasingly aware of the broad applications of fiber optics and in the last half decade, many of the authors developed a kind of obsession that for most analytical problems, there was a fiber optic solution. Even if this were true, there still exist the exceedingly difficult task of engineering the sensor and making the idea a reality. Overcoming the obstacles of reagent stability, materials compatibility, biomedical restrictions, environmental regulations is not trivial and in some cases can make the difference between success and failure. The work of Tomas Hirschfeld will be reference for years to come and used as a springboard for future R & D in fiber optic sensors. However, what was most often reported were the successful results while so much valuable information pertaining to the many chemical, mechanical, optical, analytical, and materials compatibility problems and near successes went unreported although so much was learned from these problems. The impact of any one of these factors could not only change the materials used in the sensor, but could change the overall approach to the measurement in some cases. A discussion of such problems will be presented in addition to presenting the near success of three biomedical in-vivo sensors for the measurement of potassium and sodium in blood, and an anticancer drug sensor.

45883 **Chemical analysis by beta-particle induced fluorescence.** Ivancic, W.A.; Barnes, R.H. (Battelle, Columbus, OH). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Beta particle induced fluorescence has potential for the convenient and inexpensive analysis of a large variety of chemical compounds in process streams. Results from fluorescence measurements on gaseous, liquid, and solid compounds are presented to illustrate the utility of this technique. Details will be discussed on variations in instrumentation and experimental procedures that best match the application for a number of analytical situation.

45884 **Supercritical fluid chromatography-mass spectrometry: principles and promise.** Smith, R.D. (Pacific Northwest Lab., Richland, WA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

It is generally agreed that GC-MS is superior to LC-MS in terms of detection limits and selectivity and should be the method of choice given a problem equally amenable to both techniques. It would also appear that similar considerations, though not as nearly clear-cut, should govern the choice between SFC-MS and LC-MS. For amenable analyte mixtures SFC has been well demonstrated to provide high speed or high resolution separations superior to HPLC. The flame ionization detector (FID) provides excellent sensitivity and has been demonstrated to be a useful technique for a wide range of thermally labile or less volatile compounds, but application is limited due to the small number of amenable fluids (and their low polarity) which do not give an FID response. The mass spectrometer provides an almost perfect complement for SFC that is applicable to essentially any fluid or fluid mixture and has both sensitivity and selectivity which rival GC-MS. The direct interfacing of SFC-MS, however, is not trivial (as often stated), but must be based upon an understanding of supercritical fluid solvation phenomena and processes inherent in the expansion to the low pressure environment necessary for ionization. These considerations, which involve the effects of pressure and temperature upon fluid phase solubilities, and the nucleation and precipitation increases and volatility decreases. Thus, the pressure restrictor, and the fluid expansion process through the restrictor, in conjunction with the specific ionization method, will largely define the limits of applicability for direct mass spectrometric detection.

45885 **Combined use of GC/MI/FTIR and GC/MS in the analyses of complex environmental samples.** Brasch, J.W.; Riggle, C.J. (Battelle, Columbus, OH). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

The authors have obtained both GC/MI/FTIR and GC/MS data on a variety of environmental samples. Each technique separately provides much useful data but significant improvement in characterization and identification results from combining the data sets. They have also found that the MI/FTIR data is not only 1-2 orders of magnitude more sensitive than light pipe GC/FTIR data, but also provides significantly better data for discriminating isomers and members of homologous series. These features will be illustrated with data on dioxins, PAH's, and oxygenated species in wood smoke.

45886 Remote near infrared analyses of combustion gases over optical fibers. Angel, S.M.; Stark, E. (Lawrence Livermore National Lab., CA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Continuous real-time monitoring of the combustion gases methane, propane and butane is essential to the safety of workers on off shore oil platforms, and in certain process control applications. Conventional monitoring systems provide adequate sensitivity but are difficult to maintain. Also, they contribute to the risk of explosion. A more desirable systems would have no electrical contacts and would provide remote monitoring capabilities. A near infrared optical fiber monitoring system is being developed using an incandescent lamp source, filters and a PbS detector in combination with multimode optical fiber transmitting out to 1.8 microns. The photometer uses an in line fiber optic beam chopper and lock-in amplification. The system is designed to measure 100 sensors using an advanced fiber optic multiplexer design. Also, beam randomizers are being used at the source end of the optical fibers. Preliminary results indicate a detection limit below 2% LEL is possible over 750 meters of optical fiber. Measurements are made at three wavelengths for quantitation of the combustion gases. A fourth wavelength is used to detect water vapor. The design of the system will be discussed including computer simulations and preliminary data.

45887 Tandem quadrupole/time-of-flight mass spectrometer for application to environmental analyses. Glish, G.L.; McLuckey, S.A.; McKown, H.S. (Oak Ridge National Lab., TN). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

There is an ever increasing need for techniques to meeting the growing demand for environmental analysis/monitoring. Ideally, features of such techniques include: high sensitivity and low detection limits; high sample throughout; selectivity; applicability to a wide range of different types of compounds; and low instrument cost. A tandem quadrupole/time-of-flight (QTOF) mass spectrometer has been constructed in order to apply the technique of mass spectrometry/mass spectrometry (MS/MS). It has been amply demonstrated that MS/MS is a technique that has many of the desired characteristics mentioned above. One characteristic that it has been lacking is low cost. That is one key feature of the OTOF system. An improvement in speed and sensitivity resulted from a new data acquisition system being added to the instrument. The main components of this data acquisition system are a LeCroy 4802 CAMAC crate controller and a LeCroy 4208 time-to-digital converter. An MS/MS spectrum has been obtained for dinitrotoluene (DNT) in 0.1 seconds by sampling the headspace vapor over a small solid sample. Since the saturated headspace vapor pressure of DNT is <150 ppb the actual concentration of DNT sampled must be less than this.

45888 Distribution of protamines 1 and 2 in mammals and implications with respect to protamine gene expression. Mazrimas, J.; Campos, C.; Corzett, M.; Balhorn, R. (Lawrence Livermore National Lab., CA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Recent comparisons of the distribution of the two mouse, human and hamster protamines by gel electrophoresis suggested that each species contain a different proportion of protamine 1 and 2. To investigate this further, the authors have used three different methods for quantifying the relative distribution of protamines 1 and 2 in bull, hamster, human, mouse and cat sperm. Quantitative amino acid analysis was used to determine the relative amounts of the two proteins present in protamine preparations separated by reverse-phase HPLC. Total protamine extracts were chromatographed on a 7.5mm X 300mm Nucleosil reverse-phase column using the ion pairing agent Trifluoroacetic acid and eluted with an acetonitrile gradient. Scanning microdensitometry and a dye elution technique were used to quantify the two proteins following their separation by disc gel electrophoresis in acid-urea gels and staining with Naphthol Blue Black. The proteins were also labelled with tritium by reductive methylation and quantified after gel electrophoresis by scintillation counting. The results of these analyses show that the relative proportion of the two protamines in mammalian sperm is not fixed, but the it varies widely from species to species.

45889 Mixture resolution of chemical agents detected by piezoelectric multisensor array. Olness, D.; Hirschfeld, T.; Kishiyama, K.; Steinhaus, R.; Leonard, D. (Lawrence Livermore National Lab., CA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

A good deal of work has been carried out in an effort to develop some means of detecting and identifying minutes atmospheric concentrations of chemical vapors. One candidate detector consists of a quartz crystal coated with a substrate capable of absorbing vapors of interest. The resonant frequency of the crystal is dependent on the coating mass and the amount of material absorbed. Thus, the concentration of an atmospheric compound is correlated with a change in the crystal vibration frequency. If one uses several quartz crystals instead of only one, and coats each with a different layer, the relative responses to a given vapor concentration will be different. The pattern of these responses will then be characteristics of a given vapor. For this project coatings were chosen that provide a broad range of sorption characteristics with sensitivities to the vapors of interest. The vapors include two organophosphorus-pesticide-simulants, three phosphites, and three common solvents. For the purpose of developing a mixture separation algorithm, the coating sensitivities and vapor concentrations were chosen such that the frequency shifts for pure compounds would be of similar magnitude. Such (similar) frequency responses present the most difficult challenge in devising a separation algorithm. In some cases the frequency shift corresponding to a combination of vapors is not simply the arithmetic sum of the frequency shifts for the vapors taken separately.

45890 Case studies of fiber optic sensors in process analysis. van Hare, D.R.; Prather, W.S.; O'Rourke, P.E.; Malstrom, R.A.; Spencer, W.A. (E. I. du Pont de Nemours & Co., Savannah River Lab., Aiken, SC). pp vp of Pittsburgh conference and exposition of analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

The Savannah River Plant has developed three fiber optic sensors for remote process measurement. The systems use either UV/VIS absorption or fluorescence to determine the concentrations of uranium, plutonium, and neptunium in solution. for each, unique sight glasses and optical instrument interfaces were developed. A UV/VIS fiber optic system based on a Hewlett-Packard 8451 diode array spectrophotometer is used to make on-line absorption measurements of three uranyl nitrate streams. The spectrophotometer is equipped with a fiber optic multiplexer which allows the measurement of up to four streams in series. In addition, the multiplexer has an external reference fiber at a fifth position for re-referencing the instrument. A second fiber optic system uses a Du Pont 400 two-wavelength filter photometer to monitor the elution of plutonium and neptunium from ion exchange columns. The photometer is interfaced to a process control computer and controls the switching of valves in an automated ion exchange process. A remote fiber fluorimetry (RFF) system has been developed for the measurement of uranium concentration at great distances (200 meters) from the process. RFF uses a laser excitation source and an

intensified diode array detector to measure fluorescence of uranyl nitrate solution. Both the laser excitation and fluorescence emission travel over the same optical fiber.

45891 **Environmental optic sensors.** Roe, J. (Lawrence Livermore National Lab., CA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Remote sensing of chemical composition for environmental applications can be conveniently done with a network of specific optical sensors (optrodes) hooked up to a central measurement station by optical fibers. While economics usually forces discontinuous fetch-and-carry sampling to feed a central laboratory, optical sensors will allow continuous real time monitoring at a large number of locations. The sensors here may be sensitive to instantaneous concentration or be designed for cumulative measurement of a total integrated exposure. Typically, the sensors use of single communication type fiber to deliver an illuminating laser beam to the fiber tip and to collect and bring back the fluorescent emission generated by the target analyte's interaction with an immobilized reagent at the fiber tip. Careful attention to optical systems design is required to achieve optimal conditions. Several different illuminator types have been tested and their merits compared, as were those of various arrangements for fiber multiplexing. The choice of the fiber must consider nonconventional characteristics like blue region transmission, intrinsic fluorescence, and angular smearing vs. distance. The readout system design must have highs tray light rejection as well as high quantum efficiency. For this the authors use a double monochromator, a filter or monochromator backed by a notch filter, or a double filter spatial filter sandwich. The different systems are optimal depending on the application.

45892 **Determination of impurities in plutonium by direct current plasma emission spectroscopy.** Lovell, A.P.; Del Mar, P.; Bentley, G.E. (Los Alamos National Lab., NM). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

A Beckman SpectraSpan-VI direct current plasma (DCP) emission spectrometer has been interfaced with a glove box for the quantitative determination of trace element in plutonium-containing samples. This instrument is a rapid-scanning, high-resolution spectrometer that utilizes a modified Czerny-Turner optical design with a 79-groove/mm echelle grating, operated in the 23rd through the 124th order and giving a wavelength range of 180 to 900 nm. The instrument is compact and is readily adaptable for glove box operations. Separation of the actinides from the trace elements of interest is necessary. A tributyl phosphate (TBP) extraction procedure that separates the plutonium from most of the impurity elements has been developed. The trace elements of interest remain in the aqueous phase and the actinides, with the exception of americium, extract into the organic phase. Organic material that dissolves in the aqueous phase does not affect the spectroscopic measurements. The concentration of thorium in plutonium is of great interest, and the authors are developing a separation technique utilizing thenoyltrifluoroacetone (TTA).

45893 **Use of factor analysis to study elemental covariance in the inductively coupled plasma.** Gallimore, D.; Bentley, G.E.; Wangen, L.; Peterson, E.J.; Parsons, M.L.; Quintana, M. (Los Alamos National Lab., NM). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Understanding the covariance of elements measured by inductively coupled plasma (ICP) emission spectroscopy is necessary to effectively select elements for internal standards used to improve the accuracy and precision of the method. The factor analysis statistical method is used to assess the degree and distribution of elemental covariance observed in a commercially available 49-channel ICP spectrometer system. The results of the factor analysis are used to determine the number of elements necessary to effectively provide internal standardization for all of the elements. The authors expect that there will be at least two groups of elements that covary namely, atom emission lines and ion emission lines. However, more than two groups may exist. Therefore, two or more elements will be needed to serve as internal standards for the entire set of element lines on the instrument. The authors will discuss the consequences of using an internal standard element that does covary with the analyte elements, as well as the consequences of using an internal standard that does not covary with the analyte.

45894 **Spectral characteristics of a discharge extracted from an inductively coupled plasma.** Houk, R.S.; Lim, H.B.; Lafreniere, B.R.; Fassel, V.A. (Ames Lab., IA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

A supplementary electrical discharge is generated by extracting the axial channel of an Ar inductively coupled plasma (ICP) into a small vacuum chamber. The spectral background levels and background noise emitted by this discharge are similar to those from the ICP alone. The discharge enhances the intensities of ion lines by factors of up to 13 relative to intensities observed from the ICP alone. Neutral atom lines from elements with high ionization energies ($\sim >$ 9 eV) are also enhanced but by less than ion lines; neutral atom lines from easily ionized elements are suppressed by the discharge. Metal oxides in the ICP can be seen to dissociate into atomic species as they enter the discharge. These effects are attributed to more efficient atomization, excitation, and ionization in the discharge and to the tendency of analyte species to be constricted or concentrated closer to the central axis of the ICP as they flow into the discharge. Under the same operating conditions a 40 MHz plasma generates a more intense discharge and yields higher intensity enhancements than a 27 MHz plasma.

45895 **Quality assurance - a benefit or a burden?.** Laing, W.R. (Oak Ridge National Lab., TN). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—). Contract AC05-84OR21400.

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Quality is a current buzzword and as consumers the authors may be able to go out and but it. In the laboratory, where they have the responsibility for it, it is seen from a different perspective. Quality is first viewed in terms of increased documentation and paperwork. If your laboratory works for several agencies the requirements are likely to be different. Training programs must be established and documented. Management support is required but may be lacking. People do not plan for quality and must be trained to do so. On the other hand, benefits can be seen soon after QA programs are started. Processes are brought under control and problems are resolved. QA programs which meet sponsor requirements ensure continuation of funding. Potential problems are identified and the consequences minimized. People begin to think quality and this results in better analytical chemistry and pride in their work. As the concept of quality assurance matures, the authors should look at the way they implement it. QA requirements should be standardized by some consensus organization such as ASTM with several different levels. You can choose the level appropriate to your needs and higher levels build on lower levels. Education on quality must continue from the technician level to the laboratory manager. Only when quality becomes a part of the authors thinking along with their technical expertise will they achieve the real benefits.

45896 **Impact of laboratory information management systems on quality and productivity.** Gibbon, G.A. (Pittsburgh Energy Technology Center, PA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

The Division of Coal Science of the Pittsburgh Energy Technology Center has almost ten years of experience using laboratory information management systems (LIMS). The objectives in installing the systems were to increase the productivity of the analytical laboratory staff and to enhance the quality of the work performed in the laboratory. The LIMS has had a significant impact on the quality of the work done in the laboratory. Data-capture errors have been minimized and calculation errors have been eliminated. The uniform application of quality control assurance criteria is a matter of routine, and the supervisory review of laboratory data has been greatly facilitated. The existence of large amounts of archival data has made possible the application of statistical techniques that were previously not used because of the effort involved. Final reports are prepared using uniform procedures for the rounding of numbers, as well as for the number of significant figures reported, and for statements of precision and limit of detection. Additionally, the reports are now all printed in a highly readable format.

45897 **Application of GC/FTIR to thermal degradation studies.** Demirgian, J.C.; Quandt, K.S.; Hoffman, W.L. (Argonne National Lab., IL). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Thermal degradation studies of fluids in air-free systems often require the identification of degradation products and the detection of fluid contamination by air incursion. For these studies, the use of GC/FTIR offers two advantages. First, identification of degradation products, especially among geometrical isomers, can be made based upon spectral comparison. Second, air incursion can be determined by monitoring in real time oxygen-containing products by using selected absorption windows (chemigrams). Applications and advantages of GC/FTIR to the study of thermally degraded fluids will be discussed for a selected PAH, nitrogen heterocycle, and halocarbon. The result is positive identification of isomers in less than that required by GC/MS retention-time studies and real-time fluid contamination information.

45898 **Use of analytical chemistry in characterizing a flue gas clean-up process.** Schultz, H.; Booher, H.B. (Pittsburgh Energy Technology Center, PA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

The Fluidized Bed Copper Oxide Process (FBCO) was developed at the Pittsburgh Energy Technology Center of the US Department of Energy. The process is designed to remove sulfur from the flue gases of coal burning steam generators by reaction with CuO impregnated Alumina pellets in a fluidized bed. The pellets are regenerated and the sulfur recovered by reaction with a reducing gas such as methane. The process is also designed to reduce oxides of nitrogen in the flue gas catalytically. Investigations were initiated aimed at obtaining information in two areas, 1) What are the causes of pellet attrition? Are these causes primarily chemical or physical? 2) What chemical processes are involved in the absorption, regeneration cycle? A number of analytical techniques were employed in an attempt to answer these questions. These included Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Electron Spectroscopy for Chemical Analyses (ESCA), Optical Microscopy (OM), Atomic Absorption Spectroscopy (AAS), and Classical Wet Chemical Analyses (WCA). Representative samples of unused pellets, of used and regenerated pellets, and of fly ash were obtained from experimental batch and continuous runs of the FBCO. The samples included pellets purchased from two supplies. The results indicate that a side reaction such as; 6 Cu + SO_2 + Cu_2S + 2 Cu_2O occurs during the regeneration cycle. The sulfide thus produced does not regenerate quite as rapidly as the sulfate.

45899 **Determination of formaldehyde in liquid and solid environmental matrices.** Bicking, M.K.L.; Cooke, W.M. (Battelle Columbus Div., OH). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

An analytical method will be described for the determination of formaldehyde and other carbonyl compounds in various environmental matrices. The analytes are quantified by liquid chromatography as their 2,4-dinitophenylhydrazones (DNPH). The pH dependence of the derivatization has been studied and exhibits a maximum yield at pH 4. This allows effective derivatization in acid-sensitive matrices at pH levels as high as 5. The method has been optimized for maximum recovery and includes the use of solid phase extraction technology in place of solvent extraction. Results will be presented for the determination of formaldehyde in phenol/formaldehyde and urea/formaldehyde resins. The determination of other carbonyl compounds is also possible, but the method has been optimized for formaldehyde. Formaldehyde may be determined at low ppb levels in liquid samples. This method is superior to other procedures since the reaction conditions do not artificially generate formaldehyde during the reaction. The validity of the analytical results can be verified by examining the kinetics of the reaction for standards and samples. The optimized method has been subjected to a rigorous statistical validation protocol. The attached figure demonstrates the utility of the method for the determination of formaldehyde in an industrial effluent. The formaldehyde-DNPH derivative (FOR-D) was readily quantified at 20 μg/L levels in this sample.

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REFER ALSO TO CITATION(S) 45082, 45208, 45758, 45783, 45857, 45940, 45997, 46338, 46411, 46416, 46417, 46427, 46436

45900 **(ANL/CNSV-TM—182) Organic Rankine-cycle power systems working fluids study: Topical report No. 1: Fluorinol 85.** Jain, M.L.; Demirgian, J.C.; Cole, R.L. (Argonne National Lab., IL (USA)). Sep 1986. Contract W-31109-ENG-38. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014604.

An investigation to experimentally determine the thermal stability limits and degradation rates of Fluorinol 85 as a function of maximum cycle temperatures was initiated in 1982. Following the design and construction of a dynamic test loop capable of simulating the thermodynamic conditions of possible prototypical organic Rankine-cycle (ORC) power systems, several test runs were completed. The Fluorinol 85 test loop was operated for about 3800 h, covering a temperature range of 525-600°F. Both liquid and noncondensable vapor (gas) samples were drawn periodically and analyzed using capillary column gas chromatography, gas chromatography/mass spectrometry and mass spectrometry. Results indicate that Fluorinol 85 would not decompose significantly over an extended period of time, up to a maximum cycle temperature of 550°F. However, 506-h data at 575°F show initiation of significant degradation. The 770-h data at 600°F, using a fresh charge of Fluorinol 85, indicate an annual degradation rate of more than 17.2%. The most significant degradation product observed is hydrofluoric acid, which could cause severe corrosion in an ORC system. Devices to remove the hydrofluoric acid and prevent extreme temperature excursions are necessary for any ORC system using Fluorinol 85 as a working fluid.

45901 **(CONF-871027—24) Ab initio molecular orbital investigation of the structure of $Al_2F_7^-$ and $Al_2Cl_7^-$.** Curtiss, L.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011367.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The structures of $Al_2F_7^-$ and $Al_2Cl_7^-$ have been investigated using ab initio molecular orbital theory including the effects of polarization functions in the basis sets. The $Al_2F_7^-$ ion has a linear or nearly linear Al-F-Al bridge while $Al_2Cl_7^-$ has a bent Al-Cl-Al bridge with a significant barrier to inversion (4 kcal/mol). Structures with two and three halogen atoms in the bridge were found to be less stable than the structures with one halogen atom in the bridge. 18 refs., 2 figs., 2 tabs.

45902 (CSIR-SR-CHEM—269, pp 69-83) **Structural chemistry.** 1986. National Chemical Research Laboratory, CSIR, Box 395, Pretoria, 0001, South Africa.

In Annual report 1986 [from National Chemical Research Lab., South Africa].

X-ray crystallography, NMR spectroscopy and theoretical chemistry, are becoming increasingly important in modern-day chemistry. Strong research interests in x-ray crystallograpgy, NMR spectroscopy and theoretical chemistry are essential to asssure that new developments and applications are mastered and are available to enhance the research capabilities of the laboratory. The installation of a new NMR spectrometer opens a new area of high-resolution NMR studies of solid samples. New studies initiated during the last year included investigating synthetic zeolites with /sup 27/Al and /sup 29/Si NMR, coal samples with /sup 13/C NMR, and the metabolism of cells by /sup 31/P NMR. Nineteen inorganic and eleven organic structures were determined by x-ray crystallography.

45903 (CSIR-SR-CHEM—269, pp 25-42) **Inorganic chemistry.** 1986. National Chemical Research Laboratory, CSIR, Box 395, Pretoria, 0001, South Africa.

In Annual report 1986 [from National Chemical Research Lab., South Africa].

Unusual chemical reactivity has been discovered in a series of cyclopentadienylruthenium complexes, which is giving insight into the influence of the cyclopentadienyl ring on ruthenium chemistry. Two areas of commercial exploitation appear possible from these discoveries. In the one instance, the synthetic methodology devised for these complexes has provided the only reproducible routes to high yields of saleable cyclopentadieneruthenium and osmium complexes. In the other example, initial studies with acetylenes have indicated that some of these complexes could be catalysts for the conversion of acetylenes and alkyl cyanides into substituted pyridines. Rich rewards await new highly selective routes to 2-methylpyridine, due to its extensive use as a precursor for synthetic rubbers for car tires.

45904 **(DOE/ER/13323—T1) Mechanistic studies of carbon monoxide reduction: Progress report, January 1, 1985-June 1, 1987.** Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 25 Jun 1987. Contract FG02-85ER13323. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014452.

We decided to undertake a reactivity study of the ketene clusters so as to define the chemistry of these important ligands. Other objectives were to prepare new ketene complexes with other metal ligand combinations. We considered the possibility of analogously inserting CO into metal-nitrine bonds to form free or coordinated isocyanates (μ_3-NR $\rightarrow$ μ-RNC = O). This is an important reaction because of the industrial interest in converting inexpensive nitro-organics via carbonylation into value-added products such as isocyanates, carbamates, and ureas. Thus, a second major objective of this research program was to determine if μ_3-NR ligands undergo such carbonylation chemistry. What we discovered is that halides exhibit a remarkable promoting effect on these carbonylation reactions, as they also did on the methylene carbonylation reactions. There are a number of examples of halide promoted organometallic transformations, many of them catalytic, but relatively few are understood in any detail. Thus, we began to investigate the halide promoted μ_3-NR $\rightarrow$ RN = C = O conversion in detail so as to provide fundamental information for this example. 24 refs., 9 figs.

45905 **(DOE/ER/13569—1) Transition metal activation and functionalization of C-H [carbon-hydrogen] bonds: Progress report for period June 1, 1986-November 30, 1987.** Jones, W.D. (Rochester Univ., NY (USA)). Aug 1987. Contract FG02-86ER13569. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014124.

The fundamental thermodynamic and kinetic factors that influence carbon-hydrogen bond activation at homogeneous transition metal centers were investigated. The project was also directed towards the conversion of hydrocarbons into functionalized products of potential use to chemical industry. Goals during the grant period were (1) to identify new transition metal complexes capable of activating arene and alkane C-H bonds, (2) to quantitatively evaluate the kinetic and thermodynamic stability of these complexes, and (3) to examine routes for functionalization of the activated hydrocarbons. The specific complexes involved in these studies were derivatives of the formulation $(C_2Me_5)Rh(PR_3)(R)H$, $Fe(PMe_3)_2(CNR)_3$, $Ru(PR_3)_4(R)H$, and $Rh(CNR)_5H$. Functionalization focused upon isocyanide and acetylene insertion reactions. New compounds that activated hydrocarbon C-H bonds include $HRe(PR_3)_5$, $HRe(PR_3)_2(CNR)_3$, $CpRe(Pr_3)H_4$, $CpRe(PR_3)_2H_2$, and (eta^6-C_6H_6)$Re(PPh_3)_2H$. 7 figs., 1 tab.

45906 (INIS-SU—420, pp 7-8) **Determination of ionization energies of carboranes-12 and their C- and B-derivatives.** Pustobaev, V.N.; Orlov, V.M.; Gal'chenko, G.L.; Zakharkin, L.I. (AN SSSR, Moscow. Inst. Molekulyarnoj Biologii; Moskovskij Gosudarstvennyj Univ., USSR; AN SSSR, Moscow. Inst. Ehlementoorganicheskikh Soedinenij). 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. File Number DE87780144. (MN—11231; CONF-8606301—Pt.2-Summ.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45907 (INIS-SU—423, pp 154-155) **Thermodynamics of complexing in solutions of CsCl-CuCl/sub 2/-H/sub 2/O system at 25 deg C.** Andreeva, T.A.; Golovanova, T.G.; Pozharskaya, S.S.; Soboleva, L.V. (AN SSSR, Moscow. Inst. Kristallografii). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45908 (INIS-SU—423, pp 50-51) **Thermochemistry of crystallosolvates of some metal chlorides.** Usubaliev, Dzh.U.; Kydynov, M.K.; Rysmendeev, K.R. (AN Kirgizskoj SSR, Frunze. Inst. Neorganicheskoj i Fizicheskoj Khimii; Kirgizskij Gosudarstvennyj Univ., Frunze, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45909 (INIS-SU—423, pp 7-8) **Fluorine calorimetry. Formation enthalpy of wurtzite-like boron nitride.** Leonidov, V.Ya.; Timofeev, I.V.; Lazarev, V.B.; Bochko, A.V. (Institute Vysokikh Temperatur, Moscow, USSR; Institute Obshchej i Neorganicheskoj Khimii, Moscow, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45910 (INIS-SU—423, pp 11-12) **Formation enthalpy of indium trichloride.** Stenin, Yu.G.; Filiptseva, M.Yu. 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

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45911 (INIS-SU—423, pp 13-14) **Formation enthalpy of zirconium monochloride.** Prokopenko, I.V.; Medvedev, V.A.; Tsirel'nikov, V.I. (Institute Vysokikh Temperatur, Moscow, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45912 (INIS-SU—423, pp 40-41) **Thermochemistry of products of interaction of niobium and tantalum pentachlorides with ethanol.** Nisel'son, L.A.; Tret'yakova, K.V.; Tsvetkov, V.G.; Kazimirov, V.N. (Gosudarstvennyj Nauchno-Issledovatel'skij i Proektnyj Institute Redkometallicheskoj Promyshlennosti, Moscow, USSR; Gor'kovskij Gosudarstvennyj Univ., USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45913 (INIS-SU—423, pp 46-47) **Enthalpy of crystallization of rare earth ferrite garnets.** Reznitskij, L.A.; Filippova, S.E.; Leonov, A.V.; Viting, L.M. (Moskovskij Gosudarstvennyj Univ., USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45914 (INIS-SU—423, pp 56-57) **Calorimetric study of alkali borates.** Vedishcheva, N.M.; Shakhmatkin, B.A. (Institute Khimii Silikatov, Leningrad, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45915 (INIS-SU—423, pp 60-61) **Formation enthalpy of niobium tetrachloride.** Bazhanova, L.M.; Efimov, M.E.; Medvedev, V.A. (Institute Vysokikh Temperatur, Moscow, USSR; Moskovskij Gosudarstvennyj Pedagogicheskij Institute, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45916 (INIS-SU—423, pp 90-91) **Thermodynamic properties of aluminium, chromium, yttrium and zirconium acetylacetonates.** Alikhanyan, A.S.; Malkerova, I.P.; Grinberg, Ya.Kh.; Bogdanov, V.A. (Institute Obshchej i Neorganicheskoj Khimii, Moscow, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45917 (INIS-SU—423, pp 92-93) **Thermodynamics of evaporation processes in system indium-iodine.** Chusova, T.P.; Titov, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45918 (INIS-SU—423, pp 96-97) **Entropy and enthalpy of formation of $Mn_2Mo_3O_8$ and $MnMoO_4$ evaluated from TG-measurements under controlled oxygen pressure.** Krabbes, G.; Wiesner, U.; Reichelt, W. (AZentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden, Germany, F.R.). 1986. NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45919 (INIS-SU—423, pp 98-99) **Thermodynamic functions of formation of solid solutions of gallium arsenide and indium phosphide.** Antyukhov, A.M.; Nasvetnikov, M.N. (Bryanskij Gosudarstvennyj Pedagogicheskij Institute, Byelorussian). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45920 (INIS-SU—423, pp 102-103) **Sublimation heat of niobium tetrachloride.** Bazhanova, L.M.; Izmajlovich, A.S.; Tsirel'nikov, V.I. (Moskovskij Gosudarstvennyj Pedagogicheskij Institute, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45921 (INIS-SU—423, pp 106-107) **Determination of thermodynamic values of liquid and vapor from measurements of total saturated vapor pressure.** Burylev, B.P. (Kubanskij Gosudarstvennyj Univ., Krasnodar, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45922 (INIS-SU—423, pp 108-109) **Calculation of constants and heat effects of thermal dissociation of indium chalcogenohalides.** Gadzhiev, S.M.; Bakhyshov, R.G. (Azerbajdzhanskij Gosudarstvennyj Univ., Baku, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45923 (INIS-SU—423, pp 114-115) **Mass-spectrum study of ion-molecular equilibria with the participation of higher fluorides of ruthenium and platinum.** Korobov, M.V.; Kuznetsov, S.V.; Chilingarov, N.S.; Sidorov, L.N. (Moskovskij Gosudarstvennyj Univ., USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45924 (INIS-SU—423, pp 116-117) **Mass-spectrum determination of formation enthalpies of gaseous $LaCl_4^-$ and $La_2Cl_7^-$ ions.** Kudin, L.S.; Butman, M.F.; Burdukovskaya, G.G.; Krasnov, K.S. (Ivanovskij Khimiko-Tekhnologicheskij Institute, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45925 (INIS-SU—423, pp 122-123) **Formation enthalpy of gaseous indium and thallium molybdates and thallium tungstate.** Ovchinnikov, K.V.; Semenov, G.A.; Kaposhi, O.; Lelik, L. (Leningradskij Gosudarstvennyj Univ., USSR; Budapesti Mueszaki Egyetem, Hungary). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45926 (INIS-SU—423, pp 124-125) **Thermodynamics of sublimation of rhenium tetra- and pentafluoride.** Politov, Yu.A.; Alikhanyan, A.S.; Butskij, V.D.; Pervov, V.S. (Institute Obshchej i Neorganicheskoj Khimii, Moscow, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45927 (INIS-SU—423, pp 193-194) **Thermodynamics of dissolution of Xe, O_2 and NH_3 in solvents with different structural features at 278-318 K.** Prorokov, V.N.; Zav'yalov, N.A.; Ehbanoidze, M.E.; Arutyunyan, G.G.; Kokin, N.S. (Ivanovskij Khimiko-Tekhnologicheskij Institute, USSR; Institute Khimii Nevodnykh Rastvorov, Ivanovo, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45928 (INIS-SU—423, pp 201-202) **Calculation of activity coefficients of dissolved substances from activities of solvent in multicomponent nonaqueous solutions.** Ochkin, A.V. (Moskovskij Khimiko-Tekhnologicheskij Institute, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45929 (INIS-SU—423, pp 203-204) **Enthalpies of dissolution and solvation of alkali metal fluorides in mixed solvent water-dimethylsulfoxide.** Egorov, G.I.; Krestov, G.A. (Institute Khimii Nevodnykh Rastvorov, Ivanovo, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45930 (INIS-SU—423, pp 207) **Thermodynamic study of LiCl-CsCl-H_2O system.** Khripun, M.K.; Karavan, S.V. (Leningradskij Gosudarstvennyj Univ., USSR; Leningradskij Tekhnologicheskij Institute Kholodil'noj Promyshlennosti, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45931 **(PB—87-200697/XAB) Bioconversion of methane and hydrogen to organic materials for chemical industry.** Fukui, S. (Asahi Glass Foundation for Industrial Technology, Tokyo (Japan)). 1986. 10p. (In Japanese). NTIS, PC PC E12/MF E01.

Included in Reports of the Asahi Glass Foundation for Industrial Technology, Vol. 49, 279-288(1986).

Novel methods for biochemical conversion of methane and hydrogen to organic materials were investigated. Three approaches carried out are as follows: (1) screening of methanol-accumulating strains from methane-utilizable microorganisms; (2) determination of microbiological system for formate synthesis from inorganic gases; (3) designs of apparatus for isolation and cultivation of the novel microorganisms, thermophilic-barophilic-chemolithotrophic. Approach 1 - Successful results were not obtained in screening of methanol-accumulating strains from methane-utilizable bacteria. Approach 2 - Suitable bioconversion system for formate synthesis from H_2 and carbonate could be established; the bacterium, a formate-utilizable methanogen (strain HU) accumulated 47 g formic acid in one-liter culture medium per 2 days. Approach 3 - Thermophile-barophile-chemolighotrophs are considered to be useful tools for biomass production from gaseous inorganic sources, so that cultivation apparatus for the bacteria was designed and is going to be manufactured for trial.

45932 **Cation distributions within a cluster framework. Synthesis and structure of the carbon- and boron-centered zirconium cluster compounds $KZr_6Cl_{15}C$ and $CsKZr_6Cl_{15}B$.** Ziebarth, R.P.; Corbett, J.D. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **109**: No. 16, 4844-4850(5 Aug 1987).

The structures of the isotypic $KZr_6Cl_{15}C$ and $CsKZr_6Cl_{15}B$ have been established by single-crystal X-ray diffraction in space group Pmma, Z = 4 (R = 3.1, 3.9%, R/sub w/ = 3.2, 3.6%, respectively). These contain a matrix of Z-centered $Zr_6Cl_{12}Z$ clusters linked together by trans-chlorine atoms to form separate linear and zigzag chains that are interconnected into a three-dimensional network by four additional bridging chlorides. This $(Zr_6Cl_{12}Z)Cl$/sub 6/2/ framework affords three types of chloride environments for the cations, a smaller one (a) of ten-coordination occupied by potassium or rubidium and a pair of larger sites (b) with lower multiplicity that are utilized by cesium etc. The two b-type metal sites exhibit (1) an elongated square-pyramidal environment which, for the matrix studied, leaves the cesium closer to four-coordinate and (2) a more distorted 6 + 2 position of 2/m symmetry. Some evident cation disorder especially in the b(2) site and a possible small distortion of the anion matrix are noted. Compounds of this type are made by the reaction of stoichiometric amounts of $ZrCl_4$ and Zr with C, B, or ZrNCl and the appropriate MCl in welded Ta containers at 850°C. These reactions give, according to Guinier powder diffraction, > 95% yields of $KZr_6Cl_{15}Z$, Z = C or N, with occupancy of cation site a, the isotopic (Cs or Rb)$Zr_6Cl_{15}C$ utilizing site b, and (CsK, Rb_2, or CsRB)$Zr_6Cl_{15}B$ with a and b site occupancy. All but the nitride involve 14 cluster-bonding electrons, the most preferred state according to the MO scheme.

45933 **Vibrational spectroscopic characterization of the CCO ligand and the possible occurrence of CCO on surfaces.** Sailor, M.J.; Shriver, D.F. (Northwestern Univ., Evanston, IL). *Journal of the American Chemical Society;* **109**: No. 16, 5039-5041(5 Aug 1987). Contract FG02-86ER13640.

As outlined below there is abundant evidence from metal cluster chemistry that a carbon atom capping a three-metal array has a high affinity for CO, leading to the formation of CCO. Accordingly, they propose that CCO may exist on a carbided closest-packed metal surface in the presence of CO. For example, the surface carbide species on a Fischer-Tropsch catalyst may be present as CCO. Vibrational spectroscopy represents one of the most promising methods for detecting CCO, and, therefore, they have undertaken vibrational characterization of CCO in the structurally characterized cluster $[Ru_3(CO)_8(\mu\text{-}CO)_2(\mu_3\text{-}CCO)]^{2-}$.

45934 **Catalytic activation and functionalization of C-H bonds. Aldimine formation by the insertion of isonitriles into aromatic C-H bonds.** Jones, W.D.; Foster, G.P.; Putinas, J.M. (Univ. of Rochester, NY). *Journal of the American Chemical Society;* **109**: No. 16, 5047-5048(5 Aug 1987). Contract FG02-86ER13569.

Many examples of the activation of aromatic and aliphatic carbon-hydrogen bonds by homogeneous transition-metal complexes have appeared over the past few years, offering attractive new routes to organometallic species. While several of these reports involve oxidative addition of low valent metal complexes to alkanes or arenes, these new adducts have not proven to be useful for the generation of functionalized hydrocarbon products. Reports of successful metal-based alkane functionalization include free radical oxidations, intramolecular cyclizations of alkyl carbenoid species to given cyclopentanones, aromatic isonitrile insertion to give indoles, and alkane dehydrogenation to produce olefins. Arene functionalization reactions commonly depend upon the presence of tethering groups, although the production of benzaldehyde, benzoic acid, styrene, and phenylsiloxane insertion products have been recently reported. They report here a new type of iron catalyzed insertion of isonitrile into the C-H bond of arenes to produce aldimines (eq 1). $RNC + C_6H_6\ [Fe] \rightarrow \Delta G^0 \approx -11$ Kcal/mol $C_6H_5 - CH = NR$ (1).

45935 **Electronic structure of (Na_2O)/sub x/(SiO_2)/sub 1-x/ glasses.** Murray, R.A.; Ching, W.Y. (Univ. of Kansas, Kansas City). *Applied Physics Communications;* **7**: No. 1-2, 115(Mar-Jun 1987). Contract FG02-84ER45170.

The authors used five periodic models of (Na_2O)/sub x/(SiO_2)/sub 1-x/ with x values of 0, .18, .111, .222, and .333 to simulate the sodium silicate glass system. The electronic structure of the models was calculated using the first-principles, orbital-charge self-consistent orthogonalized linear combination of atomic orbitals method. Density of states (DOS), partial DOS, localization index of

the one-electron states, and effective atomic charges were calculated for the five models of $(Na_2O)_x/(SiO_2)_{1-x}$. Systematic correlations between the calculated electronic structure and the local atomic-scale structure of the models (bond lengths, bond angles, and bond types) are presented. States at the valence band edge become much more localized as x increases.

45936 Application of EXAFS spectroelectrochemsitry to structural studies of electroactive species immobilized on polymer coated electrodes. Caster, D.M.; Heineman, W.R.; Elder, R.C.; Dewald, H.D. (Univ. of Cincinnati, OH). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Extended x-ray absorption fine structure (EXAFS) spectroelectrochemistry has proven to be a powerful technique for the structural characterization of electrochemically generated species in solution. Thin layer spectroelectrochemically allows for the rapid, complete generation of the compound in the desired oxidation state while simultaneously monitoring the x-ray absorption spectrum. In this work, the application of EXAFS spectroelectrochemistry for the structural characterization of various redox species incorporated in a polymer immobilized on the electrode surface is reported. Coordination number, donor atom types, bond distances, and oxidation state information are determined for $Fe(CN)_6$(4-/3-) species incorporated in a crosslinked poly(dimethyl diallyl ammonium chloride) (DMDAAC) coated electrode and $Ru(bpy)_3$(2+/3+) species incorporated in a Nafion coated electrode. Comparison of Fourier transformed spectra for polymer vs. solid model compounds demonstrate that the integrity of the metal complex is maintained within the polymer.

45937 Use of remote fiber spectroscopy for water chemistry monitoring in geothermal wells. Angel, S.M. (Lawrence Livermore National Lab., CA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Continuous in-situ monitoring of T, pH, and eH is of interest in water chemistry monitoring. To make these measurements requires a remote analysis system which is specific to pH and eH in the presence of the many constituents of ground water. In addition, the monitor must operate under the existing environmental conditions which are extreme in a geothermal well. The feasibility of monitoring water chemistry in geothermal wells using a combination of optrodes, optical fibers and laser spectroscopy is being studied. Here optrodes are constructed which are specific to pH and eH. The optrodes are placed in the well and connected to the spectrometer over optical fiber links. Optrodes exist which can be used to measure T, pH and eH. They will, however, not operate for very long periods at temperatures above ambient. To survive at high temperatures new optrodes are being studied which incorporate fluorescent inorganic ions in a porous ceramic matrix.

45938 Spectroscopy of the HCO radical and its relation to the photodissociation of aliphatic aldehydes. Lee, E.K.C.; Rumbles, G.; Kasatani, K. (Univ. of California, Irvine, CA). pp 2-5 of Laser applications to chemical dynamics. El-Sayed, M.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

Laser inducer fluorescence (LIF) and multiphoton ionization (MPI) spectroscopic techniques are used to investigate the HCO radical produced in the UV photolysis of formaldehyde and acetaldehyde. The LIF study has yielded vibrational and rotational information on the ground and first excited electronic states. The MPI experiment has enabled the rotational energy distribution of HCO to be examined under collision-free conditions.

45939 Picosecond dynamical temporal evolution of molecular IR absorption spectra. Kwok, H.S.; Mukherjee, P. (State Univ. of New York at Buffalo, Amherst, NY). pp 25-30 of Laser applications to chemical dynamics. El-Sayed, M.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The variation of the collisionless absorption spectral shapes for vibrationally excited SF/sub 6/ and C/sub 2/F/sub 5/Cl as a function of the picosecond probe pulse duration was determined using a two-IR frequency pump-probe scheme. The experiments revealed a spectral narrowing with decreasing pulse duration, similar to a recent observation in C/sub 3/F/sub 7/I with a single laser pulse. The observed experimental results are shown to be consistent with a dynamic multi-tier classification of energy levels in the QC of polyatomic molecules. Specifically, the time constants for such a coupling are evaluated to be >20 ps for all the molecules studied.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 45808, 46033

45940 (BNL—39700) Electronic conduction in molten sodium chloride. Haarberg, G.M.; Osen, K.S.; Egan, J.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-871027—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010063.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The electronic conductivity of molten NaCl was determined as a function of the activity of Na at 850 and 900°C by using the Wagner polarization technique. A new cell design, which prevented evaporation of Na, was essential for obtaining good results. The experimental cell consists of a tantalum crucible (6) containing NaCl (4) in contact with a Na-Bi alloy 15 mol % Na) (5), a reference electrode with a Na-Bi alloy of known composition (3) and an inert Ta electrode in a sapphire tube (8) of known geometry. The sapphire tube is filled with electrolyte, and the Ta electrode and the sapphire tube form a vacuum tight seal preventing the evaporation of Na. A constant current is applied through the cell, making the Ta cup positive and the Ta electrode inside the sapphire tube negative. The potential between the electrodes is measured as a function of time, and the stationary value obtained after a long time (40 min) is recorded. A series of such corresponding potential versus current data is measured so that the electronic conductivity can be calculated as a function of potential according to the equation $\kappa/\text{sub } e/ = G\,\partial I/\partial E$. Electron mobility does not vary much with Na activity. However, evaporation of Na from the crucible occurred during the experiment at 900°C. This caused a change in the composition of the Na-Bi alloy, corresponding to a drop in Na activity. At 850°C, the alloy composition appeared to remain constant during the experiment. 20 refs., 6 figs., 2 tabs.

45941 (CONF-8709116—1) Surface topography and electrical response of metal-electrolyte interface. Bates, J.B.; Chu, Y.T. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013553.

From 6. international conference on solid state ionics; Garmisch-Partenkirchen, F.R. Germany (6 Sep 1987).

The small-signal impedance of chemical cells with "blocking" electrodes is dominated at low frequencies ($f < \sim 100$ Hz) by the impedance of the metal-electrolyte interfaces which is accurately represented by $Z/\text{sub } i/ = A(j\omega)/\text{sup } -n/$. The frequency exponent $n(n < 1)$ is sensitive to the texture of the interface, and several recent theories have been proposed that relate n to the fractal dimension d-bar of the rough interface. However, we have found no correlation between n and d-bar from experiments using aqueous electrolytes and metal and semiconductor electrodes. A new model for the transient response of a rough electrode-electrolyte interface to a constant voltage pulse is proposed. Computer simulations, similar to the diffusion limited aggregation model, using measured profiles as a fixed (non-growing) clusters, gave exponents n in good agreement with experiments.

45942 **Fluorescence emission as a probe to investigate electrochemical polymerization process.** Kamat, P.V. (Univ. of Notre Dame, IN). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

The purpose of this study is to demonstrate the feasibility of an in situ spectroelectrochemical technique in monitoring the electropolymerization process using fluorescence emission as a probe. Such a technique should also be useful for electrochemists to study the electrode surface as well as the transients and products generated in a chemical reaction.

4005 Photochemistry

REFER ALSO TO CITATION(S) 45868, 46424

45943 **(DOE/ER/13103—2) An investigation of the photochemical properties of transition metal arene complexes: Final report for the period July 1, 1983 to June 30, 1987.** Mann, K.R. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). Aug 1987. Contract AC02-83ER13103. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014161.

The photochemical removal of the arene from CpM(eta^6-arene)$^+$ was studied for complexes of Fe(II) and Ru(II); (Fe, arene = p-dichlorobenzene, benzene, toluene, d_8-toluene, p-xylene, mesitylene, durene, pentamethylbenzene, hexamethylbenzene, hexaethylbenzene, and tri-t-butylbenzene; Ru, p-dichlorobenzene, benzene, toluene, mesitylene, pentamethylbenzene, hexamethylbenzene, and tri-t-butylbenzene). Quantum yields were determined. The photoactive state was identified as the distorted a^3E_1 ligand field excited state. The excited state energy of the Fe complexes lies about 14,000 cm^{-1} above ground state. A theoretical photophysical model was developed to relate the quantum yield for arene release to the rate of arene release. This model predicts a linear correlation between log((phi/1-phi)) and σ/sub p/, the Hammett parameter if electronic effects at the arene influence the rate of arene substitution. For chloro and methyl substituted arenes (up to 5 substituents for Fe and 6 substituents for Ru), the linear correlation was verified. The Hammett rho parameter is +1.03 and +0.53 for the Fe complexes in CH_2Cl_2 and CH_3CN solution respectively; for the Ru complexes in CH_3CN solution rho = +1.38. These data indicate a small negative charge builds up at the arene in the transition state for the arene release reaction. Deviations from the linear correlation of log(phi/(1-phi)) with σ/sub p/ were found for the sterically hindered CpFe(eta^6-HMB)$^+$, CpFe(eta^6-HEB)$^+$ and CpFe(eta^6-1,3,5-tri-t-butylbenzene)$^+$ complexes (HMB = hexamethylbenzene; HEB = hexaethylbenzene). These deviations result from steric interactions that hinder the interaction of nucleophiles in the transition state and ultimately control the quantum yield of arene release for a given complex.

45944 **(RISO-M—2644) Hexatrienes. Investigations of ground state vibrational spectroscopy, triplet sensitized photoisomerization, and structure, kinetics, and dynamics of the lowest excited triplet state.** Langkilde, F.W. (Risoe National Lab., Roskilde (Denmark)). Oct 1986. 191p. NTIS (US Sales Only), PC A09/MF A01. File Number DE87752856.

Liquid phase Raman, and gas or liquid phase FTIR spectra are obtained for E-1,3,5-hexatriene, Z-hexatriene, E,E-heptatriene, E,E,E-octatriene, and E-2,5-dimenthyl-hexatriene, and assigned on the basis of symmetry consideration, Raman depolarization ratios and IR band shapes, previous literature, and through a comparison among the hexatrienes. Previous literature on the photochemistry of hexatrienes is surveyed emphasizing the principle of Non Equilibration of Excited Rotamers (NEER) and the triplet state photochemistry. The photochemical mechanisms that are regarded to be operative in the present study are presented, and the photochemical conversion observed for each of the compounds investigated is described. Time-resolved differential absorption spectroscopy of hexatrienes excited to their lowest triplet state by pulse radiolysis, and time-resolved resonance Raman spectroscopy of hexatrienes excited to their lowest triplet state by sensitized laser flash photolysis, are described as well as time resolved Raman spectroscopy of the lowest triplet states of 2,5-dimethyl-hexatriene and hexatriene, respectively. The experimental procedures and the results are discussed. The discussion brings out information on structure, kinetics, and dynamics in the lowest excited triplet state and on potential energy surfaces in the triplet as well as in the ground state. The results suggest that the NEER principle can be extended from excited singlet to triplet states. A comparison of the triplet spectra of the various hexatrienes forms the basis of an assignment of the transient spectra, and so increases the knowledge of the structure of the triplet state of hexatrienes. This is probably an important step in extending the usefulness of time-resolved resonance Raman spectroscopy in the study of excited states. (EG). 42 refs.

45945 **Laser flash—chemiluminescence study of $O_2(^1\Delta)$ photoeliminated from 1,4-dimethylnaphthalene endoperoxide.** Chou, P.; Frei, H. (Laboratory of Chemical Biodynamics, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 7, 3843-3854(1 Oct 1987). Contract AC03-76SF00098.

Deactivation of $O_2(^1\Delta)$ photoeliminated from electronically excited 1,4-dimethylnaphthalene endoperoxide in acetonitrile and perdeuteroacetonitrile has been monitored by time resolved detection of $O_2{}^1\Delta$/sub g/$\rightarrow{}^3\Sigma^-$/sub g/ chemiluminescence at 1.27 μ. Study of the chemiluminescence decay as a function of laser photolysis pulse energy and endoperoxide concentration was undertaken in order to elucidate the processes that cause the previously reported drastic lifetime shortening of $O_2(^1\Delta)$ photoeliminated from this singlet oxygen storing molecule. Analysis of the non-first-order decay revealed that, aside from solvent collisional deactivation, quenching of $O_2(^1\Delta)$ by $O^-{}_2$ plays a dominant role at higher photolysis laser pulse energy or endoperoxide concentration. Kinetic evidence suggests that superoxide is generated upon 266 nm endoperoxide photolysis mainly along a two photon excitation path. The ionic fragmentation channel has been confirmed by direct observation of dimethylnaphthalene cation radicals in transient absorption in the red spectral range. In order to find out about the possible role of $O_2(^1\Delta)$ self-annihilation through pooling of the energy in $O_2(^1\Sigma^+)$, the rate constant of this process has been determined in a separate series of photosensitization experiments as (2.6 +- 0.8) x 10^7 l-script mol^{-1} s^{-1}(C_6F_6). This value implies that marked contribution of $O_2(^1\Delta)$ pooling to nonexponential singlet O_2 decay occurs only at high laser photolysis pulse energies or endoperoxide concentrations.

45946 **T_1 barrier height, S_1—T_1 intersystem crossing rate, and S_0 radical dissociation threshold for H_2CO, D_2CO, and HDCO.** Chuang, M.; Foltz, M.F.; Moore, C.B. (Department of Chemistry, University of California Berkeley, California 94720; Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 7, 3855-3864(1 Oct 1987). Contract AC03-76SF00098.

Vacuum UV laser-induced fluorescence has been used to detect the atomic products in the photofragmentation of H_2CO, D_2CO, and HDCO. The dissociation is shown to occur on both the ground (S_0) and the first triplet (T_1) potential surfaces. The T_1 exit barrier height (2.9—6.0 kcal/mol) and the $S_1 \rightarrow T_1$ intersystem crossing rate near the T_1 barrier top (4 x 10^7 s^{-1}) have been determined experimentally. The threshold energy for the radical dissociation channel on the S_0 surface, 86.57 +- 0.16 kcal/mol, has also been measured accurately by rovibronically resolved photolysis. The best values for the heat of formation (9.99 +- 0.19 kcal/mol) and the C—H bond enthalpy (15.69 +- 0.19 kcal/mol) of HCO radical have been derived from the measured threshold energies as well.

45947 **Room-temperature luminescence properties of rho-aminobenzoic acid adsorbed on sodium acetate-sodium chloride mixtures.** Ramasamy, S.M.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Analytical Chemistry;* **59**: No. 17, 2144-2148(1 Sep 1987). Contract FG02-86ER13547.

Room-temperature fluorescence and phosphorescence quantum yield, triplet formation efficiency, and phosphorescence lifetime values were obtained for the anion of rho-aminobenzoic acid

adsorbed on sodium acetate and several sodium acetate-sodium chloride mixtures. From these data, rate constants for phosphorescence and for radiationless transition from the triplet state were obtained. The results revealed that several factors are important for maximum room-temperature phosphorescence for the anion of rhoaminobenzoic acid. One of the most important conditions for strong room-temperature phosphorescence of the anion was how efficiently the matrix was packed with sodium acetate molecules. The same general conclusion was found for room-temperature fluorescence, but the phosphorescence quantum yield increased more dramatically than the fluorescence quantum yield.

4006 Radiation Chemistry

45948 (ZfI-Mitt—122, pp 5-38) **Kinetics of excitation and charge transfer reactions in nonpolar media.** Brede, O.; Mehnert, R.; Naumann, W. Nov 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

On the basis of rate constants determined by electron pulse radiolysis and laser flash photolysis the kinetics of energy transfer processes in nonpolar media was analyzed. The rate constants k of charge, singlet-singlet and triplet-triplet transfer show a marked dependence on the free energy of the reaction in such a way that at low energy differences ΔE, k increases with increasing exothermicity, reaching a plateau-like limit (diffusion control) at higher ΔE. This k v.s. ΔE behaviour can be attributed to the FRANCK-CONDON barrier of the high-frequency reactant modes in a transfer step as could be shown by a theoretical model taking a transfer reaction as radiationless transition in the system reactants/environment.

45949 (ZfI-Mitt—122, pp 39-62) **On the conversion of alkyl radicals to polyenyl radicals in poly(vinylchloride) - quantum chemical model calculations.** Helmstreit, W. Nov 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

In order to study different reaction pathways of the conversion of alkyl radicals to polyenyl ones in PVC different alkyl radicals and ionic species derived from the model molecule 1,3,5-trichloropentane were calculated using the MNDO method. The results of these calculations imply that an increasing effective negative charge within the PVC sequence caused by polarization effects leads to a polar transition state that can initiate polyene radical formation. The formation of polyene structures proceedes via an intramolecular dehydrochlorination reaction. On the other hand an increasing effective positive charge produced in the same way leads to a more stable structure within the PVC sequence. The formation of conjugated double bonds characterized by a simple radical mechanism should take place only at higher temperatures.

45950 (ZfI-Mitt—122, pp 63-83) **PPP and CNDO calculations on the free radical cations of styrene.** Helmstreit, W. Nov 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

Open shell calculations were carried out on the styrene monomer radical cation St/sup +./, the associated dimer radical cation St/sub 2//sup +./, and the covalently bonded dimer radical cation (St-St)/sup +./, using a PPP and CNDO/INDO method. St/sub 2//sup +./ was assumed to have a sandwich structure with different overlapping of the π-orbitals. Calculated transition energies are in agreement with the experimental data. The calculations suggest that St/sub 2//sup +./ has electronic transitions in the IR and UV/VIS range whereas those of (St-St)/sup +./ lie only within the UV/VIS range. The molecular diagrams of the investigated ions are discussed in the framework of general structure principles. The change of the total energy calculated for the reaction steps St/sup +./ + St -> St/sub 2//sup +/ -> (St-St)/sup +/ as well as the similarity of the electronic structures of St/sub 2//sup +./ and (St-St)/sup +./ suggest that the former is a precursor of the latter ion.

45951 (ZfI-Mitt—122) **Contributions to radiochemistry. Mathematical problems in modelling.** (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Nov 1986. vp. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

Separate abstracts with indexing were prepared for individual sections of the report.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 45080, 45549, 45876, 45892, 45951, 46058, 46207

45952 (CSIR-RR—598) **Fast radioiodination of rose bengal at room temperature.** Verbruggen, R.F. (Council for Scientific and Industrial Research, Pretoria (South Africa)). 1987. 16p. CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

Polyhalogenated dyes based on aromatic ring systems such as fluoresceins have been used for the evaluation of hepatobiliary function since 1909. In 1955 rose bengal was radioiodinated and a radiocontrastdye become a radiopharmaceutical. In the present study an improved method, based on the chloramine-T method, has been developed for labelling rose bengal. This method was chosen for its short reaction time, its mild conditions and its high yield. The optimum values of the reaction parameters have been determined, and resulted in a slightly higher yield, within a shorter time and without breakdown products being present.

45953 (CSIR-SR-CHEM—269, pp 11-24) **Analytical Chemistry.** 1986. National Chemical Research Laboratory, CSIR, Box 395, Pretoria, 0001, South Africa.

In Annual Report 1986 [from National Chemical Research Lab., South Africa].

Work has been done at the National Chemical Research Laboratory to develop more reliable and accurate methods for separating and determining trace elements in complex mixtures. A method has been developed to separate traces or small amounts of lead from gram amounts of elements such as bismuth, tin, indium and cadmium. A method for separating and accurately determining titanium and numerous other trace elements in molybdenum metal and its compounds has been developed by the Division as well as a method for the selective separation of nickel from all other elements. An improved, very simple method for separating pure Indium 111 from cyclotron irradiated silver targets containing some copper backing has been developed. The systematic investigation of distribution coefficients and cation exchange behaviour of elements in inorganic acid solutions containing thiourea has been continued and an electrochemical study of the relative influence of benzoate and chloride, which have either an inhibiting or accelerating effect on corrosion in neutral solutions has been completed.

45954 (INIS-mf—10249) **Chemical behaviour of plutonium in natural, aquatic systems: Hydrolysis, carbonate complexation and redox reactions.** Lierse, C. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Chemie, Biologie und Geowissenschaften). 15 Jul 1985. 245p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number DE87752447.

In order to clear up the geochemical behaviour of plutonium and its migration mechanisms in goundwater, hydrolysis, redox behaviour, compound formation in carbonate solutions and colloid formation were examined in groundwater conditions, i.e. at pH values between 5 and 8 and at redox potentials of between -300 and +700 mV. Solubility measurements, spectroscopic processes (UV, VIS, IR spectroscopy and laser induced photoacoustic spectroscopy) and electrochemical processes (cyclic voltammetry, differential pulse polarography) are used as methods of investigation. The hydrolysis constants of Pu IV and Pu VI and the solubility product of Pu (OH) /sub 4/ were determined and hydrolysis products of divalent and trivalent type are described. From solubility experiments, the stability constants for Pu (IV) carbonate compounds and the solubility product for the carbonate system of stable bodies of Pu (OH)/sub 2/ CO/sub 3/ were calculated. Using absorption spec-

troscopy, the disproportionate kinetics of Pu (V) in carbonate was determined at various pH values. A slow, but continuous, reduction in Pu (VI) was found in carbonate solution, which was derived from radiolytic effects. The speed of this auto-reduction was determined, depending on various experimental parameters.

45955 (INIS-SU—423, pp 19-20) **Formation enthalpies of fluoride complexes of systems MF-UO_2F_2 (M-alkali metal).** Suponitskij, Yu.L.; Seleznev, V.P. (Moskovskij Khimiko-Tekhnologicheskij Institute, USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45956 (INIS-SU—423, pp 112-113) **Mass-spectrum thermodynamic studies privided inlet of strong fluorination reagents.** Korobov, M.V.; Bondarenko, A.A.; Akishin, P.A. (Moskovskij Gosudarstvennyj Univ., USSR). 1986. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number DE87780174. (CONF-8606301—Pt.1-Summs.).

From 11. All-Union conference on calorimetry and chemical thermodynamics; Novosibirsk, USSR (17 Jun 1986).

45957 **(LA—11034-PR) Isotope and Nuclear Chemistry Division annual report FY 1986, October 1985-September 1986.** Heiken, J.H. (ed.). (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 265p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87014704.

This report describes progress in the major research and development programs carried out in FY 1986 by the Isotope and Nuclear Chemistry Division. The report includes articles on radiochemical diagnostics and weapons tests; weapons radiochemical diagnostics research and development; other unclassified weapons research; stable and radioactive isotope production and separation; chemical biology and nuclear medicine; element and isotope transport and fixation; actinide and transition metal chemistry; structural chemistry, spectroscopy, and applications; nuclear structure and reactions; irradiation facilities; advanced concepts and technology; and atmospheric chemistry.

45958 **Process for producing astatine-211 for radiopharmaceutical use.** Mirzadeh, S.; Lambrecht, R.M. (to Dept. of Energy, Washington, DC). US Patent 4,681,727. 21 Jul 1987. Filed date 10 Apr 1984. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A one-step chemical manipulation is described in combination with a distillation and collection process for producing At-211 comprising; a. providing a target of irradiated Bismuth coated to a predetermined thickness of a backing member, b. providing a vapor-producing still operably connected with a condenser that has a water cooled condensate collector formed of a dry silica gel mesh maintained at a temperature above the freezing point of water, and providing an effluent gas filter that is operably connected to receive effluent gas from the condenser, c. heating the target in the still at a temperature in the range of about 630°-680°C for a time period in the range of 50 to 80 minutes, to evole At-211 vapor from the target, c. providing a dry carrier gas having an oxygen concentration that is sufficient to form Bi/sub 2/O/sub 3/ thereby to essentially preclude vaporization of Bi metal, passing the carrier gas through the still to carry the At-211 vapor to the condenser, and to carry effluent from the condenser to the effluent gas filter, e. eluting At-211 from the condensate collector of the condenser with a controlled volume of eluent containing predetermined solvents that are compatible with a given desired radiopharmaceutical procedure, and f. collecting the At-211 in the controlled volume of eluent for use in the given radiopharmaceutical procedure.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 45867, 45897, 46154

45959 **(AD-A—181717/0/XAB) Integrated approach to spray-combustion model development. Report for October 1985-October 1986.** Sirignano, W.A. (California Univ., Irvine (USA). Dept. of Mechanical Engineering). Dec 1986. 33p. NTIS, PC A03/MF A01.

The major elements of an approach to the development of a more-powerful spray-combustion model is discussed. A model is sought that treats, in a numerically efficient manner, unsteady, multidimensional, turbulent reacting flows with polydisperse, multicomponent sprays and properly accounts for transient droplet heating and vaporization, liquid-phase mass diffusion, and droplet drag and trajectory. Major advances are reviewed and important issues remaining for resolution are discussed.

45960 **(AD-A—181726/1/XAB) Transient spray-combustion computations. Report for October 1985-October 1986.** Sirignano, W.A. (California Univ., Irvine (USA). Dept. of Mechanical Engineering). Sep 1986. 5p. NTIS, PC A02/MF A01.

Many practical combustion devices involves direct injection of liquid fuel into the combustion chamber, e.g., gas-turbine engines, diesel engines, rockets and ramjet engines, and furnaces. Typically, the fuel is of sufficiently low volatility that vaporization is an important or controlling factor in the rate of combustion. It is desirable, therefore, to analyze the trajectories, heating, and vaporization of the large number of droplets in a fuel spray and to account for the exchange of mass, momentum, and energy between the liquid and gas phases in order to predict combustor performance, stability, and pollutant emission. A review is made of one-dimensional, unsteady and axisymmetric, unsteady spray-combustion calculations. Proper formulation of the governing two-phase equations are discussed. Problems of ignition and flame propagation are examined. Since droplet lifetime is of the same order to magnitude as time for heat transport through the droplet, transient heating of the droplets is considered together with effects of internal droplet circulation due to shear forces on the droplet surface.

45961 **(DOE/PC/70771—T6) Kinetics of nitrogen and sulfur reactions in combustion systems: Quarterly report No. 8.** (Energy and Environmental Research Corp., Irvine, CA (USA)). [Aug 1987]. Contract AC22-84PC70771. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013752.

The heterogeneous reduction of NO via the char surface reaction is far too slow to account for the observed experimental NO reduction. During this reporting period, we have utilized modeling to estimte the possible importance of the NO reduction by soot particles in the case of coal combustion. The computational program is given in the Appendix.

45962 **Chemical Kinetic Data Base for Combustion Chemistry. Part 2. Methanol.** Tsang, W. (Chemical Kinetics Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Physical and Chemical Reference Data;* **16**: No. 3, 471-508(Jul 1987).

This publication contains evaluated and estimated data on the kinetics of reactions involving methanol and hydroxymethyl radicals and various small inorganic and organic species which are of importance for the proper understanding of methanol combustion and pyrolysis. It is meant to be used in conjunction with the kinetic data given in an earlier publication pertaining to methane pyrolysis and combustion, but which also contains a large volume of data that are applicable to the methanol system. The temperature range covered is 300—2500 K and the density range 1 x 10^{16} to 1 x 10^{21} molecules cm^{-3}.

42 ENGINEERING

REFER ALSO TO CITATION(S) 45549, 46152

45963 (CONF-871043—1) A methodology for dynamic task allocation in a man-machine system. Parker, L.E.; Pin, F.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007373.

From 2. international symposium on methodologies for intelligent systems; Charlotte, NC, USA (14 Oct 1987).

This paper presents a methodological approach to the dynamic allocation of tasks in a man-machine symbiotic system in the context of dexterous manipulation and teleoperation. This paper addresses symbiosis containing two symbiotic partners which work toward controlling a single manipulator arm for the execution of a series of sequential manipulation tasks. The proposed automated task allocator uses knowledge about the constraints/criteria of the problem, the available resources, the tasks to be performed, and the environment to dynamically allocate tasks to the man and the machine. The presentation of the methodology includes discussions concerning the characteristics of the man-machine symbiotic system, the interaction of the knowledge areas, the flow of execution, and the dynamic nature of the task allocation.

45964 (DOE/ER/12019—1) Combustion control with smart sensors: Final report for period February 1, 1982-November 30, 1986. Gouldin, F.C.; Wolga, G.J. (Cornell Univ., Ithaca, NY (USA)). Jul 1987. Contract AC02-82ER12019. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013688.

A measurement system, utilizing a runable acoustooptic filter as a smart spectroscopic sensor, has been designed and operated to determine composition and temperature of combustion gases. The system quantitatively measures infrared absorption integrated over a linear path through the combustion products on several lines of a vibration-rotation band of each gas component, after which, data analysis yields the composition and gas temperature. The computer controlled system is spectroscopically self-calibrating and is suited for process control applications. The system has been tested on CO and CO_2 produced in a flat-flame burner in which methane-air mixtures are burned. Proof-of-Principle has been demonstrated. Additional theoretical work has been done to deal with the condition of spatially non-uniform gas mixtures, which will occur closer to the combustor, knowledge of which could be significant in many process control applications. Spatially resolved data on gas temperature and composition can be obtained from multiple line-of-sight absorption measurements coupled with suitable inversion methods. The inversion problem is related to the x-ray tomographic technique but differs because the gradients in temperature and composition can be assumed to be small. The inversion work has focused on numerical and theoretical aspects of the problem. Two distinct inversion methods have resulted from this effort.

45965 (SAND—87-1370C) Store separation of nuclear weapons. Spahr, H.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-871085—1). NTIS, PC A02. File Number DE87010778.

From AEROTECH '87: Society of Automotive Engineers conference and exposition; Long Beach, CA, USA (5 Oct 1987).

Aircraft-delivered nuclear weapons continue to play an important part as the only recallable component in the United States nuclear deterrent triad. Nuclear weapons have unique characteristics which must be considered in evaluating their store separation characteristics. These considerations start in the preliminary design phase. Then, theoretical analyses, wind tunnel store separation testing, and full-scale flight drop tests are used together in a cost effective manner to evaluate store separation characteristics. Several examples of the applications of these methods are presented.

45966 (UCID—21118) Models of high spatial frequency thermal blooming instabilities. Briggs, R.J. (Lawrence Livermore National Lab., CA (USA)). 14 Aug 1987. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014280.

Simple models of the filamentation instability modes of a laser beam propagating through the atmosphere are developed. Modulation of the initial phase of the laser beam at the transmitter to compensate for atmospheric density irregularities is shown to lower the thresholds for instability onset.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 44979, 45085, 45111, 45112, 45123, 45426, 45429, 45566, 45839, 46087, 46093, 46138, 46980

45967 (AD-A—181305/4/XAB) Chemical defense collective protection technology. Volume 2. Effects of airlock airflow pattern, clothing, and exposure concentration on vapor transport. Technical paper, 11-14 February 1985. Conkle, J.P.; Miranda, R.E.; Thomas, J.; Fischer, J.R.; Page, R.W. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Apr 1987. 36p. (USAFSAM-TP—86-5). NTIS, PC A03/MF A01.

See also Volume 1, AD-A178 988.

Procedures for processing personnel through chemical defense collective shelters were employed to examine the contamination of Toxic Safe Areas (TSAs), in shelters, as a result of transport of chemical agent vapor on clothing underlayers. The quantity of vapor thus transported into the TSAs was examined as a function of: airlock airflow pattern; type of outer clothing worn during exposure; and vapor exposure concentration. A simulated Survivable Collective Protection Shelter Contamination Control Area facility, at the USAF School of Aerospace Medicine (Brooks Air Force Base, Texas), was employed. Personnel--dressed either in fatigues over T-shirt and jockey shorts, or in Flyer's charcoal under-coverall (United Kingdom) over aircrew undershirt and drawers--were first exposed to chemical warfare agent simulant (methyl salicylate) vapor, and were then processed through the Liquid Hazard Area and Vapor Hazard Area. Processing included passage through either the original design airlock or a modified design airlock before entry into the TSA. Inside the TSA, individual subjects were isolated within sealed glass offgassing booths and the vapor offgassed from each subject over a 2-h period was measured. Data indicate that the charcoal undercoverall (UK) reduced the quantity of vapor transported into the TSA, and hence increased the protection of the individual more than did the fatigues. However, no statistical evidence of airlock differences was found.

45968 (BNL—39815) Design of a long trace surface profiler. Takacs, P.Z.; Qian, Shi-nan; Colbert, J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870132—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012110.

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The design of a long-trace surface profiler for the non-contact measurement of surface profile, slope error and curvature on cylindrical synchrotron radiation (SR) mirror is presented here. The optical system is based upon the concept of a pencil-beam interferometer with an inherent large depth-of-field. The key feature of the optical system is the zero-path-difference beam splitter, which separates the laser beam into two colinear, variable-separation probe beams. A linear array detector is used to record the interference fringe in the image, and analysis of the fringe location as a function of scan position allows one to reconstruct the surface profile. The optical head is mounted on an air bearing slide with the capability to measure 38″ long aspheric optics, typical of those encountered in SR applications. A novel feature of the optical system is the use of a transverse "outrigger" beam which provides information on the relative alignment of the scan axis to the cylinder optic symmetry axis.

45969 (BNL—39943) Operating experiences and test results of six cold helium compressors. Brown, D.P.; Gibbs, R.J.; Schlafke, A.P.; Sondericker, J.H.; Wu, K.C. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-8706125—7). NTIS, PC A02. File Number DE87012115.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

Three small and three large cold helium centrifugal compressors have been operated at Brookhaven National Laboratory between 1981 and 1986. The three small cold compressors have been installed on a 1000 W refrigerator for testing a string of superconducting magnets and for R and D purposes. The three large units are components of the BNL 24.8 KW refrigerator to be used to provide cooling for the RHIC project. These compressors are used either to circulate a large amount of supercritical helium through a group of magnets or to pump on the helium bath to reduce temperature in the system. One small circulating compressor tested employs tilting-pad gas bearings and is driven by a DC motor. The two small cold vacuum pumps tested use oil bearings and are driven by oil turbines. The three large oil-bearing cold compressors are driven by DC motors through a gear box. A unique feature of the large vacuum pump is the combination of two pumps with a total of four stages on the same shaft. The adiabatic efficiencies are found to be 57% for the large vacuum pumps and close to 50% for the large circulating compressor. Good overall reliability has been experienced.

45970 **(IMechE—1987-4) Fluid machinery for the oil, petrochemical and related industries. Proceedings of the Institution of Mechanical Engineers.** (Institution of Mechanical Engineers, London (UK)). 1987. 236p. (CONF-8705186—). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

Congress papers presented cover bulk inert gas generation for enhanced oil recovery, centrifugal compression packages for offshore applications, dry gas seals for gas export compressors, and hydraulic performance testing of centrifugal compressors. Simulation of the transient performance of a compressor in a natural gas pumping station, combined motor and turbine drive, electrical variable speed drive and onshore/offshore water injection are reviewed. (U.K.).

45971 (IMechE—1987-4, pp 27-33) **Centrifugal compression packages for offshore applications.** Sayyed, S. (Delaval Stork VOF, Hengelo, NL). 1987. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ. (CONF-8705186—).

From 3. European congress of the Institution of Mechanical Engineers; Hague, Netherlands (18 May 1987).

Centrifugal compression packages for offshore applications have always received special attention due to their location in harsh environments. Special considerations are given to provide a compact, cost effective and highly reliable design, as a compressor with its driver is a among the key equipment of any production platform and failure of the unit could cause production losses which may run into millions of dollars, even in short down-times. Another aspect of paramount importance is the overall size and weight of the compression package. Basic requirements that need consideration in the selection of centrifugal compression packages for offshore applications are outlined and at the same time, a glimpse of a future package is provided.

45972 **(INIS-SU—406) Numerical experiments on /sup 3/He refrigeration by adiabatic demagnetization of copper.** Svechkareva, M.A.; Goncharov, V.A.; Rudavskij, Eh.Ya.; Fenster, M.Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 16p. (In Russian). (Preprint-no—7-86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703109.

Computational modeling and computerized experiments on liquid /sup 3/He refrigeration by adiabatic demagnitization or nuclear stage are carried out in terms of the selected physical model. The effect of various factors on minimum attainable temperature and /sup 3/He refrigeration kinetics is studied: demagnetization rate, external heat leaks, heat exchange surface between the nuclear stage and /sup 3/He, starting temperature. 6 refs.; 7 figs.; 1 tab.

45973 **(K/ETAC—30) Design verification tests for an axial gap permanent magnet compressor motor.** Hawsey, R.A.; Bailey, J.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Tennessee Univ., Knoxville (USA)). Jul 1987. Contract AC05-84OT21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014360.

A 30-hp, direct-drive, permanent magnet motor (PMM) has been constructed. The motor is to operate at 15,000 rpm and is designed to drive a Worthington compressor at the US DOE-owned gaseous diffusion plants. The PMM prevents traditional dynamometer testing, including locked rotor current, voltage, and torque measurements. A test plan is presented for data acquisition on the dynamometer test stand in order to calculate the equivalent circuit for the motor. A description of the hardware required for these measurements is included in the plan.

45974 **(K/SUB—85-03528/2) Process support compressor motor electromagnetic design summary.** Bailey, J.M. (Tennessee Univ., Knoxville (USA). Dept. of Electrical Engineering). Mar 1987. Contract AC05-84OT21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014359.

A 30-hp, 15,000-rpm, permanent magnet motor has been designed and is now being built. The direct drive motor has 72 slots and eight poles. Using A. O. Smith Magnetic, a flux plot was obtained and the flux density throughout one pole pitch has been determined. The poles are connected in a four-pole series, parallel WYE. Each pole requires 30 A for a total per phase current of 60 A. The torque capability is 2638 oz-in.

45975 **(KFK—4260) Magnetoelastic buckling in superconducting toroidal magnet systems.** Geiger, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Mar 1987. 109p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-10863.

The lateral positions of coils in toroidal magnet systems can become unstable above a critical value of the current as a result of a magnetoelastic interaction. This effect is called magnetoelastic buckling. In a first step, the buckling effect was verified with a special coil of simple structure. The buckling theory was confirmed with great accuracy in these experiments. In a second step, the buckling effect was studied in the TESPE arrangement, a toroidal magnet system of a design and size relevant to technical demands. A generalized theoretical model was developed for the calculation of the buckling behavior. The measurements of buckling behavior showed that elastic stiffnesses can vary greatly as a function of the current in a torus of complex design. Monitoring of the frequencies of the lateral normal modes is proposed as a way of controlling mechanical stability in operation.

45976 **(LBL—22170) Controlling laboratory conditions and preventing the problem: The health physicist's viewpoint.** de Castro, T.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1986. Contract AC03-76SF00098. 9p. (CONF-860891—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014079.

From Denver X-ray conference; Denver, CO, USA (4 Aug 1986).

This document contains the text of a presentation on safety problems associated with the use of analytical x-ray equipment. General comments on the positive and negative aspects of both administrative and hardware controls preceded a more detailed discussion of specific examples in each area. Also included were comments on machine safety by the manufacturer and suggestions for further reading on the safe use of x-ray diffraction and spectrometry equipment. (TEM)

45977 **(MINTEK-M—244D) The recovery of graphite from borehole-core samples.** Guest, R.N.; Logan, C.T. (Council for Mineral Technology, Randburg (South Africa). Ore-dressing Div.). 30 May 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900933.

A study was made of two borehole-core samples from a graphite deposit in northern Lebowa. Much of the graphite was found to be interlaminated with biotite, sericite, kaolinite, and iron-stained gangue minerals. Flat, elongated quartz grains were also found to be present in the material. Upgrading of the material was found to be extremely difficult because of its mineralogical structure, the highest grade of concentrate obtained being only slightly higher than 70% carbon. The interlamination of magnetic material with much of the graphite causes removal of the latter by magnetic separation, thus reducing the recovery. Flotation of the fraction finer than 75 μm with extensive cleaning and magnetic separation produced a concentrate with a graphite content of only 61% at a recovery of 81%. The finely laminated nature of the material makes upgrading and recovery of the graphite extremely difficult.

45978 **(N—87-23936) Straight cylindrical seal for high-performance turbomachines.** Hendricks, R.C. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1987. 76p. (NASA-TP—1850; E—3184; NAS—1.60:1850). NTIS, PC A05/MF A01.

A straight cylindrical seal configuration representing the seal for a high-performance turbopump (e.g., the space shuttle main engine fuel pump) was tested under static (nonrotating) conditions. The test data included critical mass flux and pressure profiles over a wide range of inlet temperatures and pressures for fluid nitrogen and fluid hydrogen with the seal in concentric and fully eccentric positions. The critical mass fluxes (or leakage rates) for the concentric and fully eccentric configurations were nearly the same when based on stagnation conditions upstream of the seal. The fully eccentric configuration pressure profiles of the gas and liquid were different. Further, the pressure differences between the maximum and the minimum clearance positions were highly dependent on the geometric conditions, the temperature, and the absolute pressure at both the inlet and the exit. The pressure differences were greatest in the inlet region. The results, although complex, tend to follow the corresponding-states principles for critical flows. Gaseous injection near the seal exit plane significantly altered the pressure profiles and could be used to control turbomachine instabilities.

45979 **(N—87-23979) Thermomechanical effects in high-speed seal rubs. Final report, 26 February 1979-31 December 1984.** Kennedy, F.E. Jr. (Dartmouth Coll., Hanover, NH (USA)). Jun 1987. 9p. (NASA-CR—180418; NAS—1.26:180418). NTIS, PC A02/MF A01.

The analytical effort was aimed at development of numerical model of thermal and mechanical phenomena which occur during seal rub. Finite element programs were develped for studying the temperatures that result from frictional heating during rubs, and the plastic deformation which is caused by rub forces. The experiment phase was originally intended to aid in verification of the results of the analytical model. Experimental techniques were developed for measuring surface temperatures and deformations during single pass rubs. Modifications were made to the device to permit testing at both high and cryogenic temperatures. The results from the experiments are discussed.

45980 **(N—87-24641) Space station experiment definition: Long-term cryogenic fluid storage. Final report.** Jetley, R.L.; Scarlotti, R.D. (Beech Aircraft Corp., Boulder, CO (USA)). Jun 1987. 257p. (NASA-CR—4072; E—3463; NAS—1.26:4072; BAC-ER—18056-8). NTIS, PC A12/MF A01.

The conceptual design of a space station Technology Development Mission (TDM) experiment to demonstrate and evaluate cryogenic fluid storage and transfer technologies is presented. The experiment will be deployed on the initial operational capability (IOC) space station for a four-year duration. It is modular in design, consisting of three phases to test the following technologies: passive thermal technologies (phase 1), fluid transfer (phase 2), and active refrigeration (phase 3). Use of existing hardware was a primary consideration throughout the design effort. A conceptual design of the experiment was completed, including configuration sketches, system schematics, equipment specifications, and space station resources and interface requirements. These requirements were entered into the NASA Space Station Mission Data Base. A program plan was developed defining a twelve-year development and flight plan. Program cost estimates are given.

45981 **(ORNL/M—376) The stack and vent survey.** Dumont, J.N. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87014169.

This document summarizes data obtained from a survey of all stacks and vents at the Oak Ridge National Laboratory. The survey data are contained in the STACKS database maintained by the Department of Environmental Monitoring and Compliance, Oak Ridge National Laboratory. The survey was designed to obtain information about the character of the laboratory's stack and vent systems and their potential emissions. The database has been compiled from survey data and identifies all known stacks and vents at the laboratory and, qualitatively, their potential emissions.

45982 **(SAND—86-2962C) An autonomous, closed-loop pointing system for use with satellite optics.** Woods, R.O. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-8708110—4). NTIS, PC A02. File Number DE87012011.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

The availability of microcomputer control has allowed a new design philosophy to be introduced which is of particular interest for remote or unattended instrumentation. Instead of attempting to create systems that will retain their attributes (e.g., mechanical dimensions) in the presence of all perturbations, it is now possible to use an arrangement in which errors are expected, but reduced to tolerable values by the exercise of machine intelligence. This involves sensors to monitor performance and effectors that actively reduce the error. With such a concept it is frequently possible to achieve better results with lighter and more compact hardware and to eliminate the need for human intervention to retain calibration. The presence of a microcomputer also makes it possible for a machine to perform functions that were previously left to human judgment. One of these, the resolution of seeming ambiguities, is the subject of this paper.

45983 **(SAND—87-0118C) Aerodynamic design and performance of a bent-axis geometry vehicle.** Rutledge, W.H.; Polansky, G.F.; Clark, E.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-870830—7; AIAA—87-2491-CP). NTIS, PC A02. File Number DE87013726.

From AIAA aerodynamics flight mechanics conference; Monterey, CA, USA (17 Aug 1987).

Variable bent-axis maneuvering vehicles provide a unique type of control for a variety of supersonic and hypersonic missions. Unfortunately, the large hinge moments often associated with these vehicles have prevented their application. This study examines the application of both experimental data and Computational Aerodynamics (CA) techniques in the design of such vehicles. A procedure is presented for the efficient design of a bent-axis geometry given a set of system constraints. In particular, the selection of vehicle parameters to produce minimum hinge moments for trimmed flight is examined in detail. Finally, the overall performance of the bent-axis geometry is reviewed in terms of static stability, lift/drag ratio and control effectiveness.

45984 **(SAND—87-0473) Exact solutions to the governing dynamic equations of plasma armature electromagnetic railguns.** Shahinpoor, M.; Hawke, R.S. (New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering; Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014442.

General governing nonlinear differential equations pertaining to the dynamic behavior of a plasma armature electromagnetic railgun are first derived. Three different cases are then considered and the corresponding governing equations are then solved exactly by means of a set of nonlinear transformations. These cases correspond to (1) no-ablation, (2) continuous-ablation, and (3) partial-ablation for which an ablation threshold velocity nu/sub t/ plays a fundamental role. Corresponding to each case, a nonlinear transformation

is employed to reduce the nonlinear differential equations to their equivalent linear ones and subsequently allow solution of the pertinent linear differential equations, which are second order, by means of the transition matrix technique. It is concluded that in order to achieve very high projectile velocities the projectile should be injected into the railgun at velocities higher than the ablation threshold velocity. Thus, the ablation may be completely alleviated and the ensuing turbulent drag may be significantly diminished. It is shown that under these conditions one may typically accelerate projectiles up to 30 km/s or more while without hypervelocity injection, for the same railgun and typical operating conditions, one might severely limit the maximum projectile velocity.

45985 **(SAND—87-0481C) Integrating voice I/O in the specification and operation of alarm processing and display systems.** Funkhouser, B.R.; Moseley, M.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-8710104—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011636.

From AVIOS '87: voice input/output systems applications conference; Alexandria, VA, USA (6 Oct 1987).

45986 **(SAND—87-1006C) Effects of barrel joints on hypervelocity projectiles.** Shahinpoor, M.; Asay, J.R.; Dixon, W.R.; Hawke, R.S. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—52). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013447.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Development of new hypervelocity launchers is necessary for equation of state (EOS) studies at high impact velocities. The requirements for barrel joint alignment and concentricity at high velocities place severe constraints on fabrication and assembly procedures; small steps or longitudinal direction changes at joints may cause major damage to precision projectiles. Research has been initiated to identify the technical limits of fabrication and assembly tolerances for hypervelocity gun barrels. Numerical and experimental studies have evaluated projectile performance at velocities of 6 to 15 km/s and have identified failure modes for Lexan projectiles with thin metal facings.

45987 **(UCRL—15930) Description of a multiframe optical probing system.** Willi, O. (Lawrence Livermore National Lab., CA (USA); Willi (O.), London (UK)). Jul 1987. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014255.

A multiframe optical probing system is briefly described. This system allows several images separated in time to be taken on each laser shot. Consequently, it is extremely attractive for investigations of the temporal behavior of the plasma blow-off.

45988 **(UCRL—96479) Railgun development for EOS [equation-of-state] applications: A status report.** Hawke, R.S. (Lawrence Livermore National Lab., CA (USA)). 30 Jun 1987. Contract W-7405-ENG-48. 8p. (CONF-870753—69). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011876.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Several groups have pursued the development of railguns into hypervelocity launchers. Some have focused on their application for high pressure equation-of-state (EOS) research. In the course of development, technical problem areas were discovered. Recent work has concentrated on solving these problems which include: (1) ablation of barrel walls, (2) contamination of the plasma armature by ablation products, and (3) formation of parasitic secondary arcs. Potential solutions to these problem areas are being implemented in the Sandia National Laboratory Albuquerque (SNLA) railgun system. The system uses a two-stage light-gas gun (2SLGG) as an injector to minimize barrel ablation and armature contamination. Hydrogen is used as the injection gas and will also serve to reduce the probability of forming secondary arcs. Other critical issues under investigation include: (1) barrel precision requirements, (2) barrel joint design, (3) viscous drag, and (4) plasma armature formation. VISAR will be used for continuous precision projectile velocity measurement. The combination of precision diagnostics and the new experimental techniques under investigation will provide a firm basis for fulfillment of the railgun's potential as a hypervelocity EOS system.

45989 **Microcomputer-based system of thermal and impact codes for analysis of shipping-cask designs.** Chun, R.C.; Johnson, G.L.; Nelson, T.A.; Serbin, R. (Lawrence Livermore National Lab., CA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

This paper describes a microcomputer-based system of computer programs and databases called SCANS (shipping cask analysis system) that was developed at the Lawrence Livermore National Laboratory (LLNL) for the United States Nuclear Regulatory Commission (NRC). SCANS is used to calculate the response of a nuclear spent-fuel cask to impact and thermal loads. The impact loads and the cask stress responses are calculated with a dynamic one-dimensional beam model. The thermal loads and the cask temperature responses are calculated with a transient two-dimensional finite-element code which includes phase changes, time- or temperature-dependent boundary conditions and internal heat generation. A two-dimensional linear elastic static structural code is used to calculate the thermal stresses from the temperature distributions. SCANS is useful for performing sensitivity studies and for evaluating the safety analysis reports on spent fuel casks that are submitted to the NRC. Poster presentation. 5 references, 12 figures.

45990 **Comparison of static and dynamic finite-element methods for shipping-container impact analyses.** Witte, M.C. (Lawrence Livermore National Lab., CA). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

There is wide variation in the methods used to analyze shipping containers for impact conditions. It is common practice in the waste-transportation industry to use a quasi-static analysis method to gain an understanding of how a cask will behave during an impact accident. Quasi-static analyses simplify a truly dynamic problem to a static problem by making the assumption that the decelerations are uniform and constant. Because these methods involve static analyses, they are much less expensive than the corresponding dynamic finite-element analysis. A study was made for one cask, comparing the stress, strain and lead slump for three drop situations. The most important conclusion is that the quasi-static method gives non-conservative results for the shipping container considered in this study. Poster presentation. 5 figures, 8 tables.

45991 **Testing and evaluation of used UF_6 shipping packages.** Barlow, C.R.; Ziehlke, K.T.; Pryor, W.A.; Housholder, W.R. (Oak Ridge Gaseous Diffusion Plant, TN; Martin Marietta Aerospace, Orlando, FL; Nuclear Containers, Inc., Elizabethton, TN). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Damage to shipping packages and their components, whether due to normal environmental exposure or because of unforeseen accidents, requires occasional re-evaluation and requalification to assure the suitability of the packages for continued service. Pressure tests were conducted on used Model 30B cylinders that were involved in a warehouse fire to assess the possible damaging effects of the exposure. Deteriorated and mechanically damaged overpacks that had absorbed large quantities of water in service were subjected to drying tests, foam properties were evaluated, and a rehabilitation procedure was developed to allow return of such packages to service. Protective shipping packages show deterioration with extended service, principally structural damage from rough handling and rust damage from exposure to weather and from storage practices that may promote absorption of water by the insulating foam. The structural and thermal properties of the phenolic-foam insulation from used shipping packages were found not to be adversely affected by absorbed water, nor were they degraded by the drying process. In order to slow down or prevent continuing rust damage in renovated packages, however, a process was developed for drying the foam in commercial facilities prior to restoration work on used on damaged containers. Drying progress was monitored by weight loss and a simple moisture meter was also found useful in tracking water content through the drying cycle. Two Model 30B cylinders were involved in a warehouse fire, where portions of the cylinders were estimated to have reached a temperature of 1140 K. The cylinders were empty at the time of the fire and thus were not in the protective packages in which full product cylinders are handled while in transit. Hydrostatic burst tests showed that the integrity of the cylinders was not degraded by the fire exposure.

45992 **Revision of the ANSI N14.5 leak-test standard.** Fischer, L.E.; Lake, W.H.; Leisher, W.B.; Taylor, W.R. (Lawrence Livermore National Lab., CA; Nuclear Regulatory Commission, Washington, DC; Sandia National Labs., Albuquerque, NM; Atomic Energy of Canada Ltd., Chalk River, Ontario). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Between January 1983 and September 1985, a subcommittee formed by the American National Standards Institute (ANSI) N14 Main Committee performed a periodic review of the ANSI N14.5-1977 Standard: Leakage Tests on Packages for Shipment of Radioactive Material. In this paper, the subcommittee discussed 16 identified issues, along with the changes they made in revising the N14.5 Standard. The issues are: (1) IAEA vs the US Code of Federal Regulations (10CFR71); (2) confusing units, e.g. atmcc/s; (3) definitions: leaky, leaktightness; (4) types of flow/mixed media; (5) leakage boundaries: swipe tests; (6) fabrication test: processes; (7) in-service inspection: joints; (8) integral/discrete leakage; (9) quantitative/qualitative; (10) references/calculations; (11) leakage direction; (12) measuring methods/equipment; (13) driving force effects; (14) seal configuration/testing; (15) simplification of Appendix B; (16) sample size. Poster presentation. 4 references, 1 figure, 1 table.

45993 **Experimental data base for estimating the consequences of a hypothetical sabotage attack on a spent fuel shipping cask.** Sandoval, R.P.; Luna, R.E. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The results of a programme conducted at Sandia National Laboratories for the United States Department of Energy to provide an experimental data base for estimating the radiological health effects that could result from the sabotage of a shipping cask carrying light-water-reactor spent fuel are described. The primary objectives of the programme were limited to (1) evaluating the effectiveness of selected high-energy devices (HED) in breaching full-scale spent fuel casks; (2) quantifying and characterizing relevant aerosol and radiological properties of the released radionuclides; (3) using the resulting experimental data to evaluate the radiological health effects resulting from a hypothetical attack on a spent-fuel shipping cask in a densely populated urban area. Subscale and full-scale tests, in conjunction with an analytical modelling study, were performed to meet the programmatic objectives. The results of this study indicated the following. (a) Because the source terms, as measured, never produced the threshold dosage for early fatalities and morbidities, the number of early fatalities and morbidities predicted was zero. (b) The total latent cancer fatalities as a result of initial exposure, particle resuspension, and long-term exposure to contaminated ground were predicted to be 2/7 (mean/pack). Test procedures and measurement techniques are discussed in detail. Results of the tests and analyses as well as implications of these results are presented. 3 references.

45994 **Fracture-mechanics approach to spent-nuclear-fuel transportation cask design.** Sorenson, K.B.; Salzbrenner, R. (Sandia National Labs., Albuquerque, NM). pp vp of Packaging and transportation of radioactive materials (PATRAM '86). Proceedings of an international symposium on the packaging and transportation of radioactive materials held in Davos, 16-20 June 1986. Vienna, Austria; IAEA (1987). (CONF-860604—).

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

The Transportation Technology Center at Sandia National Laboratories (SNL/TTC) is assessing the potential of using materials other than stainless steel in the manufacture of nuclear transport-cask bodies for service in the United States of America. The programme deals with issues of concern from the standpoint of US licensing and design, specifically failure modes at low temperatures with impact loading, fracture-mechanics properties, and validation of analytic codes which model cask response due to impact loading. Specific materials which will be dealt with in the course of this programme are (i) ductile cast iron (DCI); (ii) low alloy ferritic steel (FS); (iii) depleted uranium (DU). Current efforts are focused on DCI, primarily because this material is of immediate interest to the cask industry and there is an ample supply of material available for testing, while FS will be dealt with in the near future and DU subsequent to FS. 7 references, 4 figures, 1 table.

45995 **MPD thruster scaling.** Kelly, A.J.; Jahn, R.G.; Gilland, J.H. Colorado Springs, CO; AIAA (1987). 10p. (AIAA-Paper—87-0997; CONF-870558—).

From 19. international electric propulsion conference; Colorado Springs, CO, USA (11 May 1987).

Full scale and half scale versions of the Princeton Benchmark and Flared Anode self-field MPD thrusters have been investigated to determine the influence of scale and design upon MPD behavior. Thruster performance determined by impulsive thrust and terminal voltage measurements is found to depend primarily on propellant flow rate and the ratio of electrode radii, but not on thruster size. Current distributions obtained from magnetic field probes are independent of scale for both thruster designs. Voltage depends upon current, electrode geometry, and propellant flow rate. This behavior agrees qualitatively with calculations based on a fundamental MHD formulation. 10 references.

45996 **Gradient index retroreflector.** Layne, C.B. (to Dept. of Energy). US Patent Application 6-836,882. 6 Mar 1986. 20p. Contract AC04-76DP00789. DE87007303 NTIS, PC A02/MF A01; GPO Dep. File Number DE87007303.

A retroreflector is formed of a graded index lens and a reflective coating at one end. The lens has a length of an odd multiple of a quarter period thereof. Hexagonally shaped graded index lenses may be closely packed in an array to form a retroreflecting surface.

4203 Lasers

REFER ALSO TO CITATION(S) 45689, 45827, 46025, 46026, 46039, 46059, 46068, 46450, 46781, 46826, 46889, 46925, 46927

45997 **(AD-A—181316/1/XAB) Physical chemistry of energetic nitrides. Final report, 1 November 1983-30 April 1987.** Coombe, R.D. (Denver Univ., CO (USA). Dept. of Chemistry). 28 May 1987. 95p. NTIS, PC A05/MF A01.

This program has addressed a number of aspects of the chemistry of energetic nitrogen-based compounds. Topics investigated include the photochemistry of halogen isocyanates and halogen amines, radiative and collisional relaxation processes in electronically excited halogen nitrenes, mechanisms of collisional decomposition of halogen azides, and production of excited metastable nitrogen molecules (in azide-based reactions) for the collisional excitation of laser-candidate species. The data obtained offer insight into the storage of energy in metastable halogen azides, halogen isocyanates, and halogen amines, and the mechanisms by which this energy is released when these molecules are stimulated by photolysis or undergo chemical reactions.

45998 **(AD-A—181447/4/XAB) Blue-green laser-diode research program. Revision. Quarterly Progress report No. 4, 1 January-31 March 1987.** Mar, H.A.; Smith, T.L.; Walker, C.T. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electronic and Information Sector Labs.). May 1987. 70p. NTIS, PC A04/MF A01.

Revision of report dated Apr 1987.

During this reporting period, Na-doping work continued, and, in addition, work began with P and Sb doping. The laboratories also began to use a new 6N super high-purity Se source material obtained from Osaka Asahi, with consequent marked improvement in unintentionally-doped material quality. As evident from this report, extrinsic donor impurities from the source materials may be responsible for the difficulties encountered in obtaining p-ZnSe. Efforts in double-crystal x-ray rocking curve (DCRC) and transmission electron microscopy studies, as well as e beam and optical pumping, and Schottky and ohmic contact work are continuing.

45999 **(AD-A—181653/7/XAB) Coherent summation of Nd:YAG lasers. Final report, 1 October 1986-31 March 1987.** Harrison, J.; Rines, G.A.; Moulton, P.F. (Schwartz Electro-Optics, Inc., Concord, MA (USA)). 24 May 1987. 22p. NTIS, PC A02/MF A01.

Binary gratings were used to achieve coherent beam summation at 1.06 micrometers using diode-laser-pumped Nd:YAG ring lasers. Mutual coherence of two such devices was achieved by optical injection locking. This is believed to be the first demonstration of cw injection locking of solid-state lasers other than semiconductor diode lasers. The two sources were combined, both free-running and phase-locked, while varying the phase of one source at the grating. The results show very efficient beam summation in a configuration that could be used to combine a large number of individual lasers.

46000 **(AD-A—181656/0/XAB) New discharge pumping method for CO_2 lasers. Technical report (Final), 26 September 1986-30 May 1987.** Jacob, J.H. (Science Research Lab., Inc., Somerville, MA (USA)). 27 May 1987. 52p. (—01-F-1987). NTIS, PC A04/MF A01.

A new pulsed-laser-discharge concept is proposed to meet military and civilian requirements for efficient operation of compact, high-energy CO_2 lasers. This discharge concept promises pulse lengths of up to 100 microseconds duration scalability to multi-kilojoule pulsed energy, high volumetric efficiency (> or = 50 Joules/liter-atm), and high electrical efficiency (> or = 20%). This discharge concept relies on a new method for maintaining discharge stability for long pulse durations. This new CO_2 laser discharge concept promises increased efficiency, repetition rate, laser pulse length, extracted energy per unit volume and reliability. The concept utilizes a current source to insure volumetric stability. Such a source will not stabilize the discharge against streamer formation. Streamer formation can be inductively inhibited by the use of RF. Hence, an RF current source could result in a more stable laser discharge.

46001 **(AD-A—181792/3/XAB) Efficient side-lobe suppression of laser-diode arrays.** Leger, J.R.; Swanson, G.J.; Holz, M. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 20 Apr 1987. 4p. (JA—5946). NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 50, No. 16, 1044-1046(20 Apr 1987).

An optical technique is described that converts multilobed far-field patterns from in-phase laser arrays into a single-lobed pattern. The technique redistributes the output light from the laser array to produce a uniformly illuminated aperture. This filled aperture produces negligible side lobes, and efficiently channels the array power into the main lobe. Experiments performed on a ten-element Y-guide laser array show an increase in main lobe power from 51 to 90% of the total array power.

46002 **(BNL—39971) On the collective variables description of a high gain free electron laser.** Gjaja, I. (Brookhaven National Lab., Upton, NY (USA); Columbia Univ., New York (USA). Dept. of Physics). Jun 1987. Contract AC02-76CH00016. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013315.

It has been shown that the linearized equations describing the motion of electrons and the development of the radiation field in a free electron laser (FEL) can be conveniently studied using the collective variable approach. The advantage of this method is that the equations are greatly simplified, while the variables remain physically easily recognizable quantities. In this report two methods are used to construct the collective variables and deduce their linearized equations of motion: the Vlasov-Maxwell approach, where the distribution function f and the radiation field are linearized about equilibrium, and the many particle approach in which the linearization is performed for the dynamical variables of all the particles and the radiation field. In both cases the transverse effects and the dependence of the radiation field on spatial coordinates are included. The two approaches are equivalent.

46003 **(DOE/DP/40200—46-Vol.30) LLE [Laboratory for Laser Energetics] review: Volume 30: Quarterly report, January-March 1987.** Delettrez, J. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1987. Contract FC08-85DP40200. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014469.

This volume of the LLE Review, covering the period January-March 1987, contains an improved x-ray microscopy technique for characterization of inertial fusion targets; improvements in the coefficient for inverse bremsstrahlung laser absorption; an analysis of new geometries for x-ray laser studies and the results of inertial experiments; and the National Laser Users Facility activities for this period. Finally, the laser activities on GDL and OMEGA are summarized. Three reports have been cataloged separately.

46004 (DOE/DP/40200—46-Vol.30, pp 45-53) **X-ray microscopy of inertial fusion targets using a laser-produced plasma as an x-ray source.** 1987. NTIS, PC A04/MF A01 . File Number DE87014469. Contract FC08-85DP40200.

In LLE [Laboratory for Laser Energetics] review: Volume 30: Quarterly report, January-March 1987.

The x-ray microradiography technique for the characterization of inertial fusion targets has been improved through the use of a laser-produced plasma as an x-ray source. This new method has extended the resolution to which layer thicknesses can be measured to 0.4 μm.

46005 (DOE/DP/40200—46-Vol.30, pp 54-67) **Improvements in the coefficient for inverse bremsstrahlung laser absorption.** 1987. NTIS, PC A04/MF A01 . File Number DE87014469. Contract FC08-85DP40200.

In LLE [Laboratory for Laser Energetics] review: Volume 30: Quarterly report, January-March 1987.

The logarithmic factor in the classical coefficients for inverse-bremsstrahlung absorttion of laser light has been derived to take into account the high electron density conditions near the critical surface of a target irradiated with 351-nm laser light. Comparison with previously used models shows variations of 20 to 50%.

46006 (DOE/DP/40200—46-Vol.30, pp 68-87) **Studies of new geometries for x-ray lasers.** 1987. NTIS, PC A04/MF A01 . File Number DE87014469. Contract FC08-85DP40200.

In LLE [Laboratory for Laser Energetics] review: Volume 30: Quarterly report, January-March 1987.

New geometries have been proposed for x-ray laser studies; they include two exploding foils, two ablating slabs, and a pair of exploding/ablating foils. Simulation and experimental results show higher electron density in the lasing region and improved transverse electron density profiles.

46007 **(LA-UR—87-2147) Sideband suppression by an intracavity optical filter in the Los Alamos free-electron laser oscillator.** Goldstein, J.C.; Newnam, B.E.; Warren, R.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 21p. (CONF-8709110—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011740.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

Experiments at the Los Alamos free-electron laser oscillator were performed with a 7.35% ($\Delta\gamma$/sub r//γ/sub r/) tapered wiggler. Multilayer dielectric mirrors with wavelength-dependent reflectivity and phase shift functions were used to provide high reflectivity at the fundamental wavelength but to introduce losses at expected sideband wavelengths. The electron-beam energy was varied to tune the fundamental optical wavelength. Experimental measurements are compared with results of 1-d time-dependent simulations. For the particular wiggler, optics, and e-beam conditions of this experiment, spectral sidebands were reduced only with a concomitant reduction of the total optical output of the laser. 18 refs., 12 figs.

46008 **(LA-UR—87-2538) Method for single-shot measurement of picosecond laser pulse-lengths without electronic time dispersion.** Kyrala, G.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-8708110—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87013171.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A two-source shear pattern recording is proposed as a method for single-shot measurement of the pulse shape from nearly monochromatic sources whose pulse lengths are shorter than their coherence times. The basis of this method relies on the assertion that if two identical electromagnetic pulses are recombined with a time delay greater than the sum of their pulse widths, the recordable spatial pattern has no fringes in it. At an arbitrary delay, translated into an actual spatial recording position, the recorded modulated intensity will sample the corresponding laser intensity at that delay time, but with a modulation due to the coherence function of the electromagnetic pulse. Two arrangements are proposed for recording the pattern. The principles, the design parameters, and the methodologies of these arrangements will be presented. Resolutions of the configurations and their limitations will be given as well.

46009 **(UCRL—95419) Magnetic field diagnostics for an FEL [free-electron laser] wiggler.** Kulke, B.; Coffield, F.; Deis, G.; Frye, R.; Kallman, J. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 5p. (CONF-870302—246). NTIS, PC A02. File Number DE87013492.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Magnetic field measurements have been peformed on a 5-m wiggler magnet array that forms part of a free-electron laser experiment currently in operation at LLNL. The pre-installation tests used a Hall probe to map the transverse field on and near the beam axis, and integrating coils to determine the cancellation errors that tend to steer the beam. For on-line diagnostics, we use a bank of 31 rotating-coil gaussmeters that are mounted off-axis but from which the on-axis field is inferred. The gaussmeters form part of a closed-loop control system through which the operator can set and automatically maintain a desired field profile to within 0.1%. The paper discusses pre-installation measurement and calibration techniques and results, and operational experience with the closed-loop control system.

46010 **(UCRL—96263) A simple self-breaking 2 MV gas switch.** Di Capua, M.S.; Freytag, E.K.; Dixon, W.R.; Hawley, R.A. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-870656—45). NTIS, PC A02. File Number DE87014346.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

We describe a simple self-breaking 2 MV gas master switch for the LLNL 2 MV general purpose relativistic electron beam (REB) accelerator. The switch cavity has been hollowed out in a 17.8 cm-thick acrylic slab. The switch gap is 3.55 cm. At 2 MV the maximum field at the cathode is 740 kV cm^{-1} and the maximum envelope field is 172 kV cm^{-1}. The maximum measured switching voltage is 1.90 +- 0.1 MV (10 bar abs). The minimum switching voltage is 1.1 MV (4.3 bar abs). The operating characteristics break away from the 89 kV/(cm atm) dc breakdown strength of SF_6 at 5 bar abs. Careful electrical and mechanical design as well as strict quality control during assembly and operation have resulted in reliable and reproducible operation.

46011 **X-ray gain in neonlike ions from inner-shell ionization of sodiumlike ions by suprathermal electrons.** Goldstein, W.H.; Walling, R.S. (High Temperature Physics Division, Lawrence Livermore National Laboratory University of California, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **36**: No. 7, 3482-3485(1 Oct 1987).

We propose a new scheme for obtaining soft x-ray gains in neonlike ions. The scheme relies on inner-shell ionization of sodiumlike ions by suprathermal electrons. Since this amplifier will operate with, in principle, no population in the neonlike ground state, the power requirements for scaling to higher Z may be reduced, and the problem of line trapping is eliminated. Model calculations for selenium are presented to verify measurable gain and the experimental feasiblity of the scheme is briefly discussed.

46012 **Compressive coatings on optical components for improving mechanical durability and increasing strength.** Marion, J.E. (Lawrence Livermore National Lab., Livermore, CA). pp 56-61 of Topical meeting on optics in adverse environments (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—). Contract W-7405-ENG-48.

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

In slab lasers, the active elements are single crystals or glass with rectangular geometries in sizes up to 1 x 10 x 20 cm for single crystals and 2 x 25 x 70 cm for glass. During laser operation, the slabs are heated throughout their bulk by absorption of flashlamp light, but only the surfaces are cooled by flowing liquid or gas. The consequent steady state thermal gradient results in surface tensile stresses that can exceed the component strength, resulting in catastrophic failure. Furthermore, during handling and operation, the slab strength degrades by the accumulation of physical damage on the slab surface. Therefore, in addition to high strength, the slabs must be mechanically durable. The author investigates a variety of methods to achieve good mechanical durability and high strength within the context of optically flat, low scatter, low absorption surfaces.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 45222, 45314, 45983

46013 **(AGARD-AG—298-VOL-1) Aeroelasticity in axial-flow turbomachines. Volume 1: unsteady turbomachinery aerodynamics.** Platzer, M.F.; Carta, F.O. (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Mar 1987. 276p. NTIS, PC A13/MF A01.

The field of unsteady turbomachinery aerodynamics is reviewed. Linearized unsteady aerodynamic theory, classical two-dimensional methods, three-dimensional flows, unsteady transonic flow, stall flutter, forced vibration, fan blade flutter, and unsteady aerodynamic measurements on rotors are among the topics discussed.

46014 **(DOE/ER/10810—2) Flow and heat transfer with impinging jets and rough surfaces: Final report for the period of November 1, 1980 to December 31, 1986.** Goldstein, R.J.; Jabbari, M.Y. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). Jul 1987. Contract AC02-81ER10810. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014162.

A series of studies were undertaken to investigate heat transfer from impinging jets and rough surfaces. In some of the studies, liquid crystals and naphthalene sublimation techniques were developed and used to determine the temperature distribution and the heat (mass) transfer coefficients, respectively. In the process of these investigations, a new data acquisition system, operated and controlled by computers, was developed, constructed, tested, and employed. A Laser-Doppler velocimeter was used to measure velocity and Reynold stresses in a two-dimensional wall jet. Single, multiple, and oblique jets, and the effects of entrainment and confinement on impingement heat transfer were studied. Investigations of three-dimensional heat (mass) transfer at the base of a cylinder protruding from a surface was carried out. Similar tests with an array of in-line and staggered cylinders were also conducted. The local heat transfer from a surface covered with two-dimensional periodic ribs was investigated. Distribution of the heat transfer coefficient on bottom and sidewall surfaces of a two-dimensional cavity was experimentally determined.

46015 **(N—87-23925) Thermodynamic evaluation of transonic compressor rotors using the finite volume approach.** Moore, J.; Nicholson, S.; Moore, J.G. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Dec 1986. 83p. (NASA-CR—180587; NAS—1.26:180587; JM—87-4). NTIS, PC A05/MF A01.

Final Report, 20 December 1984-19 December 1986.

The development of a computational capability to handle viscous flow with an explicit time-marching method based on the finite volume approach is summarized. Emphasis is placed on the extensions to the computational procedure which allow the handling of shock induced separation and large regions of strong backflow. Appendices contain abstracts of papers and whole reports generated during the contract period.

46016 **(N—87-24145) Upwind and symmetric shock-capturing schemes.** Yee, H.C. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). May 1987. 130p. (NASA-TM—89464; A—87236; NAS—1.15:89464). NTIS, PC A07/MF A01.

The development of numerical methods for hyperbolic conservation laws has been a rapidly growing area for the last ten years. Many of the fundamental concepts and state-of-the-art developments can only be found in meeting proceedings or internal reports. This review paper attempts to give an overview and a unified formulation of a class of shock-capturing methods. Special emphasis is on the construction of the basic nonlinear scalar second-order schemes and the methods of extending these nonlinear scalar schemes to nonlinear systems via the extact Riemann solver, approximate Riemann solvers, and flux-vector splitting approaches. Generalization of these methods to efficiently include real gases and large systems of nonequilibrium flows is discussed. The performance of some of these schemes is illustrated by numerical examples for one-, two- and three-dimensional gas dynamics problems.

46017 **Entropy generation in convective heat transfer and isothermal convective mass transfer.** San, J.Y.; Worek, W.M.; Lavan, Z. (Illinois Institute of Technology, Department of Mechanical and Aerospace Engineering, Chicago, IL 60616). *Journal of Heat Transfer;* **109**: No. 3, 647-652(Aug 1987).

The irreversible generation of entropy for two limiting cases of combined forced-convection heat and mass transfer in a two-dimensional channel are investigated. First, convective heat transfer in a channel with either constant heat flux or constant surface temperature boundary conditions are considered for laminar and turbulent flow. The entropy generation is minimized to yield expressions for optimum plate spacing and optimum Reynolds numbers for both boundary conditions and flow rigimes. Second, isothermal convective mass transfer in a channel is considered, assuming the diffusing substance to be an ideal gas with Lewis number equal to unity. The flow is considered to be either laminar or turbulent with boundary conditions at the channel walls of either constant concentration or constant mass flux. The analogy between heat and mass transfer is used to determine the entropy generation and the relations for optimum plate spacing and Reynolds number. The applicable range of the results for both limiting cases are then investigated by non-dimensionalizing the entropy generation equation.

46018 **(N—87-24673) Experimental studies on the stability and transition of 3-dimensional boundary layers.** Nitschke-Kowsky, P. (National Aeronautics and Space Administration, Washington, DC (USA)). Jun 1987. Translation of Experimentelle Untersuchungen zu Stabilitaet und Umschlag dreidimensionaler Grenzschichten, DFVLR, 19 Jun 1986. (NASA-TM—88539; NAS—1.15:88539; DFVLR-FB—86-24). 114p. NTIS, PC A06/MF A01.

Three-dimensional unstable boundary layers were investigated as to their characteristic instabilities, leading to turbulence. Standing cross-flow instabilities and traveling waves preceding the transition were visualized with the hydrogen bubble technique in the boundary layer above the wall of a swept cylinder. With the sublimation method and hot film technique, a model consisting of a swept flat plate with a pressure-inducing displacement body in the 1 m wind tunnel was studied. Standing waves and traveling waves in a broad frequency are observed. The boundary layer of this model is close to the assumptions of the theory.

46019 **Prediction of turbulent source flow between corotating disks with an anisotropic two-equation turbulence model.** Shirazi, S.A.; Truman, C.R. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-73.

An anisotropic form of a low-Reynolds-number two-equation turbulence model is implemented in a numerical solution for incompressible turbulent flow between corotating parallel disks. Transport equations for turbulent kinetic energy and dissipation rate were solved simultaneously with the governing equations for the mean-flow variables. Comparisons with earlier mixing-length predictions and with measurements are presented. Good agreement between the present predictions and the measurements of velocity components and turbulent kinetic energy was obtained. The low-Reynolds-number two-equation model was found to adequately model the near-wall region as well as the effects of rotation and streamline divergence which required ad hoc assumptions in the mixing-length model.

46020 **Solutions of steady-state and unsteady-state equations on the IBM-PC simulating heat transfer and chemical reaction across a gas-liquid film.** Khan, A.A. (Development Div., Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., Oak Ridge, TN 37831). pp 919-926 of Modeling and simulation. Hanham, R.; Vogt, W.G.; Mickle, M.H. Pittsburgh, PA; University of Pittsburgh (1986). (CONF-8604298—). Contract AC05-84OR21400.

From 17. annual Pittsburgh conference on modeling and simulation; Pittsburgh, PA, USA (24 Apr 1986).

Steady-state and unsteady-state equations modeling heat transfer across a reacting gas-liquid film of hydrogen, molten lithium, and lithium hydride are presented. The steady-state equations were solved with the TK-SOLVER program on an IBM-PC. The unsteady-state equations were also solved. The simulated reactor's response to various inputs is demonstrated.

4205 Materials Testing

REFER ALSO TO CITATION(S) 45084, 45171, 45335, 45425, 45732, 45994, 46091, 46102

46021 (DOE/ER/45267—1) [Surfaces and thin films studied by picosecond ultrasonics]: Annual progress report for period July 1, 1986 to November 30, 1987. Tauc, J. (Brown Univ., Providence, RI (USA)). 1987. Contract FG02-86ER45267. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013920.

Research supported by this grant (DE-FG02-86ER45267) is directed towards the exploration of a new method for studying very high frequency phonons in real time. The picosecond pump and probe technique on which the method is based makes it possible to study longitudinal phonons in a much higher frequency range than the conventional ultrasonics and can be used at any temperature. In the first period of the grant we have built a new opto-electronic system dedicated for these studies. We have studied phonons in Ge:Si multilayer structures and interpreted them in terms of normal modes; in these structures we have observed a localized surface mode which appears to be ideally suited for studying phonon attenuation in the material, as well as the properties of interfaces. We have shown that some vibrations of large molecules seen by the picosecond photomodulation technique can be interpreted as normal modes of the molecule seen in real time. We have studied the transmission of phonons between two materials and have shown that the Kapitza resistance for the heat flow is easily observable in the picosecond range. We have developed a theory of the Kapitza resistance between two different materials with fcc structures. We have done some exploratory measurements on the use of this method as a non-destructive technique for studying very thin films and coatings with possible technological applications.

46022 (EGG-M—16687) An acoustic emission digital data acquisition workstation. Johnson, J.A.; Barna, B.A.; Allemeier, R.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 8p. (CONF-870679—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012425.

From 5. symposium on energy engineering sciences; Argonne, IL, USA (17 Jun 1987).

A digital acoustic emission (AE) data acquisition system has been used to record the acoustic emissions generated by individual crack initiation sites during fracture. The purpose of this research is to analyze the dynamics of crack growth and to discriminate among fracture mechanisms through pattern analysis of the received signals. Preliminary experiments were performed using a laser as an AE source for calibration, and data were collected from a tensile test of an aluminum surface-cracked specimen. During the laser calibration experiments the AE from a focused Nd-YAG laser spot, which was translated 2.0 mm across a sample in 0.1 mm steps, was recorded and used to locate the origin of the AE. The results showed the basic capability of the system to discriminate between initiation sites less than 100 μm apart. The aluminum fracture experiment showed the capability of an enhanced system to record real events with a response time of less than 12 ms between events. The dynamics of the initiation site evolution show the progression of the crack growth across the pre-crack tip. Research is now being pursued to both validate these preliminary results and utilize the information on the dynamics of the fracture event.

46023 (K/ETAC—23) Damping characteristics of a composite-reinforced stainless-steel tube. Andriulli, J.B.; Grimsby, H.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012455.

The investigation of damping characteristics of composite-steel laminates was initiated for the Naval Underwater Systems Center in March 1987. Phase I of the Composite Damping Task consists of fabricating a hoop-wound, fiber reinforced stainless-steel tube and comparing the damping characteristics to that of a "bare" stainless-steel tube. This report summarizes the activities initiated under Phase I of this project performed at the Enrichment Technology Applications Center, Martin Marietta Energy Systems, Inc.

46024 (SAND—87-0725C) Computations of hypervelocity impact using the CTH shock wave physics code. Zeigler, F.J.; McGlaun, J.M.; Thompson, S.L.; Trucano, T.G. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—57). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013067.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Computer simulations of several hypervelocity impact events using the multi-dimensional, multi-material CTH shock wave physics code are presented and discussed. First, some two-dimensional CTH calculations are presented. These are then compared with calculations using another Eulerian shock wave physics code (CSQ) and with flash x-ray photographs of the impact events. Fully three-dimensional computations, including simulations of oblique impacts, will then be presented. Possible improvements in the physical and computational models used in the calculations will be mentioned. The influence of these calculations on CTH development will be discussed.

46025 Average-power 1064-nm laser-induced damage testing at Lawrence Livermore National Laboratory. Hildum, E.A.; Rainer, F.; Milam, D. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA 94550). pp 324 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

A new facility for studying damage induced under average-power irradiation by 1064-nm laser pulses has been built at LLNL in support of several laser development programs. The laser light source produces 0.6 J/pulse in 16-ns pulses at repetition rates up to 120 Hz. The high pulse repetition rate is obtained by interleaving the beams from four commercial 30-Hz YAG lasers fired under computer control. The beams are combined with thin-film polarizers and three $\lambda/2$ waveplates rotated under computer control in synchronism with the lasers. The resulting beam is focused by a 2-m focal length lens to obtain fluences in excess of 20 J/cm/sup 2/. The long-term goal is to test a variety of thin films and substrate materials to determine the relationship between single-pulse fluence and component lifetime in conditions of a high pulse repetition rate and average power irradiation. Components to be evaluated include both dielectric and metallic substrate materials and optical films deposited by solgel or e-beam techniques.

46026 Time to failure in single-pulse laser-induced damage. Boyer, J.D. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87545). pp 324 of Proceedings of the conference on lasers and electro-optics. Piscataway, NJ; IEEE Service Center (1987). (CONF-870401—).

From OSA/IEEE conference on lasers and electro-optics (CLEO '87); Baltimore, MD, USA (27 Apr 1987).

Time-resolved measurements of laser light scattered from the damage site during irradiation are a useful probe of damage mechanisms. Irradiation of test specimens in a series of test energy densities ranging from near threshold to well above threshold results in a distribution of damage times, energy densities at damage, and intensities at damage. Analysis of the results shows whether intensity or energy density is more important in initiating damage in the test specimen. In addition, the light scattered from test optics during damage has temporal characteristics which may yield yet another morphological classification useful in the study of laser-induced damage to optical components, or more generally, laser material interactions. While the increase in scatter is both dramatic and rapid for uncoated silica, many quarterwave reflecting stacks show an initial decrease of scatter at damage followed by a sharp rise later in the damaging pulse. The typical damage signature from two-layer antireflection coatings differ from both of those in that the initial change in scatter is more gradual but frequently followed by a sharp spike late in the pulse. An additional complication in single-pulse damage was not observable for a few specimens even at energy densities 10 times the damage threshold. For these, two to three shots were needed to produce either visible or scatter UV damage signatures.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 45803, 45816, 45828, 46124, 46131, 46723, 46909, 46976

46027 **(CONF-8709116—4) Dielectric response of ionic conductors.** Bates, J.B.; Wang, J.C. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013552.

From 6. international conference on solid state ionics; Garmisch-Partenkirchen, F.R. Germany (6 Sep 1987).

Impedance measurements on (ZrO_2)/sub 0.87/(Y_2O_3)/sub 0.13/ in the range from 0.1 Hz to 10 MHz reveal an apparent frequency dependent conductivity that is typical of ionic conductors. Analysis of the impedance and the dielectric permittivity using empirical expressions for dielectric relaxation such as the Havriliak-Negami function shows that the frequency dependence of the conductivity can be attributed to dipole relaxation of defects, possibly (V_0Y)-Y' pairs, with relaxation times that are determined by the hopping rate of oxygen vacancies.

46028 **(DOE/CE/15319—T4) [High energy semiconductor switch]: Second quarterly technical report, May 24, 1987 to August 24, 1987.** (Risberg Power Electronics, Inc., New Berlin, WI (USA)). 28 Aug 1987. Contract FG01-87CE15319. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014112.

46029 **(EPRI-AP—5210) Reactive power management device assessment: Final report.** Venkata, S.S.; El-Sharkawi, M.A.; Liu, C.C. (Washington Univ., Seattle (USA). Dept. of Electrical Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 91p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920568.

Induction generators in wind power stations require a large amount of reactive power to operate. As a possible means of improving the power factor, the adaptive power factor controller (APFC) is being developed by the University of Washington under the sponsorship of Bonneville Power Administration and the Southern California Edison Company. The purpose of this EPRI project was threefold: to provide documentation of the APFC design, to compare the device with existing reactive compensation devices and to develop methods for technical and economic evaluation of reactive power controllers. In this report, functional blocks of the latest APFC design are described. Results of a comprehensive literature and patent search are summarized and a comparison is made between the APFC and other existing reactive power control devices. Analytical methods are given for the evaluation of power factor and voltage profiles (with and without the APFC), and fault diagnosis of transducers and SCRs. Reactive compensation leads to higher power factors and reduced line losses. In this report a parametric method is proposed for the cost/benefit analysis of APFC application. 47 refs., 39 figs., 9 tabs.

46030 **(SAND—86-2997) TA566A Power Controller/Encoder: SANDUS.** LeBlanc, R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014445.

The TA566A Power Controller/Encoder, designed to operate in the MA164 Digital Data Acquisition System, is used to control ac power to the Data Collection elements (crates) and to several of the Common Equipment elements of the MA164. It also monitors the power and health status of the MA164 elements and encodes this information for transmission to the outside world.

46031 **(SAND—86-2998) TA489A calibrator: SANDUS.** LeBlanc, R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014444.

The TA489A Calibrator, designed to operate in the MA164 Digital Data Acquisition System, is used to calibrate up to 128 analog-to-digital recording channels. The TA489A calibrates using a dc Voltage Source or any of several special calibration modes. Calibration schemes are stored in the TA489A memory and are initiated locally or remotely through a Command Link.

46032 **(SAND—87-0686C) Operation of a p-channel, GaAs/(In,Ga)As, strained quantum well field-effect transistor at 4 K.** Zipperian, T.E.; Drummond, T.J.; Fritz, I.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-8708113—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013816.

From 11. IEEE biennial conference; Ithaca, NY, USA (10 Aug 1987).

Structural and environmental factors affecting strain-induced light-hole conduction in GaAs/(In,Ga)As/GaAs, strained quantum well field-effect transistors (SQWFETs) are reviewed. Important parameters are biaxial compression, valence band nonparabolicity, two-dimensional hole concentration, and temperature. To examine the effects of temperature on transistor performance, a p-channel SQWFET with a 3.5 μm Cr/Au gate was fabricated from a modulation-doped GaAs/In/sub 0.2/Ga/sub 0.8/As/GaAs quantum well structure. Well-behaved transistor action and high transconductances were observed from 300 to 4 K.

46033 **(SAND—87-1110C) Voltammetric investigation of porous silicon for integrated circuit applications.** Kelly, M.; Guilinger, T.; Tsao, S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871027—13). NTIS, PC A02. File Number DE87009287.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Silicon-on-insulator (SOI) is the generic name for one class of full dielectric isolation. There are several techniques for achieving desired SOI structures, including zone melt recrystallization, high dose oxygen or nitrogen implantation, and oxidation of porous silicon. We utilize the directed growth of porous silicon (PS) to isolate silicon islands upon which microcircuits will be fabricated. The porous silicon is then thermally oxidized to produce a fully dense, insulating silicon dioxide layer. Silicon can be made porous by making it the anode in an electrochemical cell containing aqueous hydrofluoric acid (HF). We present the results of a voltammetric study of the electrochemical reaction mechanism of PS formation in dilute HF. It can be stated that larger overpotentials (and resultant larger porous silicon formation rates) are required in more concentrated HF solutions to produce a large enough rate of SiO_2 formation to passivate the electrode. 2 refs., 5 figs.

46034 **(SAND—87-1189C) Evaluation of stand-alone inverters for remote applications.** Bower, W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 19p. (CONF-871027—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010957.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

A stand-alone or autonomous system that supplies ac electric power to loads in remote applications is a mini-utility. It requires all the basic elements of a large system. These basic elements are an energy source, a storage medium, and a power conditioner (inverter) with built-in or external control and distribution capabilities. The source for an autonomous system will probably be one of the renewable sources of energy such as wind or photovoltaics. The electrical storage will be a battery bank. The inverter, with the variable energy source and the energy storage sized for the autonomy of the system, must be capable of converting the energy and supplying controlled ac power to the loads on demand and in a safe, efficient, reliable, and compatible manner. This paper describes the evaluation of several small (typically 1-kW) stand-alone power conditioners. The purpose of these evaluations was to determine the dc input and ac output characteristics of the power conditioners, the control algorithms, and the compatibility and interactions of the power conditioners with the complex loads most likely to be used with the stand-alone or autonomous systems.

46035 **(SAND—87-1494C) On adaptive signal processing of rf signals.** Ahmed, N.; Armstrong, B.; Rogers, C.; Elliott, G.R. (New Mexico Univ., Albuquerque (USA); Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 16p. (CONF-8706189—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014192.

From International symposium on the mathematics of neworks and systems; Phoenix, AZ, USA (18 Jun 1987).

This paper addresses the problem of extracting a chirp-like signal from noise which is in the form of narrowband rf interference. An adaptive prediction approach is proposed. Computer simulation results and some hardware aspects are also included.

46036 **(UCRL—96264) Response of helical structures to high speed pulses or when can a helix be called an inductor?.** Di Capua, M.S.; Molau, N.E.; Wheeler, P.C. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1987. Contract W-7405-ENG-48. 7p. (CONF-870656—46). NTIS, PC A02. File Number DE87014347.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Vacuum and dielectric cored loosely wound helices are widely used in pulse power systems. In one extreme, when the applied pulse length is shorter then the transit time in the helix, helices are used as transit time isolators, to lead signals from high voltage terminals to ground. In the other extreme, for pulse durations that are much longer than the transit time, helices act as conventional inductors and are used for high frequency isolation or as shields for trigger, signal or gas leads to pulse power components. In either case, the use of helices in the presence of fast pulses requires an understanding of their behavior in regimes where time delays associated with wave propagation in the helix are not negligible when compared to the length or risetime of the applied pulse and hence their description as lumped elements is no longer correct. This paper describes the results of analytical approximations, circuit simulations, 3-D time dependent electromagnetic modeling as well as laboratory measurements on helices surrounded by conducting structures. On the basis of these investigations their suitability as voltage measuring devices will be discussed.

46037 **Theory and simulation of high-power microwave generation in a magnetically insulated transmission line oscillator.** Lemke, R.W.; Collins Clark, M. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117-6008). *Journal of Applied Physics;* **62**: No. 8, 3436-3440(15 Oct 1987).

The magnetically insulated transmission line (MITE-LINE) oscillator is an electron beam diode comprised of a field emitting cathode and a corrugated anode. The device is similar to a linear magnetron except that the insulating magnetic field is self-generated. The self-insulating property makes this device a robust high-power microwave tube. Using the thin-beam approximation we have derived a dispersion relation for a cylindrical MITE-LINE oscillator. The dispersion relation is used to predict frequency and growth rate of the microwave generating instability. Analytical results are compared with c-smcapsc-smcapsu-smcapsb-smcapse-smcaps particle simulations.

46038 **Stability of amorphous silicon alloy materials and devices.** Stafford, B.L.; Sabisky, E. (eds.). New York, NY; American Institute of Physics (1987). 406p. (CONF-870116—). American Institute of Physics, 335 E. 45th Street, New York, NY 10017 $58.00. File Number TI87012236. Contract AC02-83CH10093.

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

The 51 papers are arranged under the following headings: light-induced phenomena, solar cell stability, thermal and hydrogen effects, defect phenomena and modeling, and submodule performance. (DLC)

46039 **All-metal resonator designs for visible/near-infrared free-electron laser oscillators.** Newnam, B.E. (Los Alamos National Lab., Los Alamos, NM). pp 21-22 of Topical meeting on optics in adverse environments (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

The multiple radiation environment of future high-current free-electron laser (FEL) oscillators poses severe requirements on the resonator mirrors. In addition to withstanding the high-average power, high-repetition-rate pulses of the fundamental laser radiation, the optical properties of the mirrors must not be degraded by the attendant optical harmonics, gamma rays, neutrons, electrons, and vacuum. Furthermore, the initial mirror absorption must be low enough so that the reflected wavefront distortion is tolerable when various types of mirror cooling are employed. Multilayer dielectric reflectors for visible- and near-infrared wavelengths are known to be susceptible to damage or degradation by several radiation hazards, and experimental data to support their use in the presence of some of the other radiations is now available. To assure that future operation of high-power oscillators is not limited by optical damage considerations, the author proposes the use of ring-resonators consisting of all-metal mirrors. One such resonator design includes multiple-facet, end mirrors and intracavity beam-expanding mirrors each used at grazing incidence. The metal of choice for wavelengths longer than 500 nm is vacuum-deposited silver although gold and copper films are possible alternatives. At such large angles with S-polarization, the metal mirrors are much less susceptible to degradation from exposure to the high-energy radiations than are dielectrics. Further, scaling to large sizes should be within the potential capabilities of the optical industry.

46040 **Development of a large-aperture PLZT shutter with enhanced operational/environmental capabilities.** Harris, J.O. Jr.; Cutler, R.P.; Dulleck, G.R. (Sandia National Labs., Albuquerque, NM 87185). pp 57-61 of Proceedings of the 6th IEEE international symposium on applications of ferroelectrics. Piscataway, NJ; IEEE Service Center (1986). (CONF-8606214—).

From Institute of Electrical and Electronics Engineers international symposium on applications of ferroelectrics; Lehigh, PA, USA (8 Jun 1986).

PLZT thermal/flash protective shutters ranging in size from 25mm to 101mm in diameter have been developed by Sandia National Laboratories for industrial and military applications. A larger diameter shutter, 147mm, with enhanced environmental and operational capabilities was required for window ports. This paper describes a production PLZT shutter which provides these characteristics via the incorporation of new lens sealing techniques, packaging design, polarizers, and electronic subsystems.

4209 Waste Processing Plants And Equipment

46041 **(AD-A—181453/2/XAB) Sulfur hexaflouride as a tracer for the verification of waste-destruction levels in an incineration process. Final report, May 1984-April 1986.** Proctor, C.L.; Berger, M.C.; Fournier, D.L.; Roychoudhury, S. (Florida Univ., Gainesville (USA). Dept. of Mechanical Engineering). Apr 1987. 104p. NTIS, PC A06/MF A01.

The use of sulfur hexafluoride (SF_6) as a tracer for the verification of hazardous-waste destruction levels in an incineration process is discussed. This study determined the relationships between fuel flow, air flow, temperature, and mixing, and the destruction removal efficiency (DRE) of SF_6 in a laboratory natural gas burner. The motivation for the study was the need to establish fundamental relationships that could be used in later studies concerned with using SF_6 as a tracer in combustion processes. SF_6 was mixed with natural gas and burned in a turbulent diffusion flame, typical of industrial boiler flames. The SF_6 DRE was determined for various air and fuel flow rates, and for two different burner mixing conditions. Laboratory samples of three compounds typically found in Air Force hazardous wastes were also vaporized samples of three compounds typically found in Air Force hazardous wastes were also vaporized and burned. The compounds were toluene, benzene, and trichloroethylene. The DREs of these compounds were greater than the DRE of SF_6 when burned under the same conditions. An empirical relationship was developed, relating the DRE of SF_6 to a characteristic time, based on fuel flow and adiabatic flame temperature, and an empirical rate constant, based on the adiabatic flame temperature.

46042 **(WSL-LR—579(MR)M) Recovery of non-ferrous metal from pulverised refuse - a feasibility study.** New, R.; Papworth, R. (Warren Spring Lab., Stevenage (UK)). Jul 1986. 23p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ.

Testwork has been undertaken to examine the feasibility of recovering non-ferrous metal from pulverised domestic refuse. The results indicate that a concentrate assaying 75% by wt non-ferrous metal may be recovered from a heavy reject stream arising from the production of refuse derived fuel. However, further work is required to optimise the unit processes before consideration can be given to the installation of a flowsheet at an existing refuse sorting plant.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 44949, 44950, 44951, 44952, 45210, 45725, 45729, 46041

46043 **(DOE/ID/12138—7) Development of a gas-side fouling measuring device.** Marner, W.J.; MacDavid, K.S. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1987. Contract AI07-80ID12138. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014462.

A gas-side fouling measuring device has been designed, constructed, and tested in a laboratory setting. The cylindrical probe, made of stainless steel, is cooled with compressed air and utilizes a temperature control system to maintain a constant wall temperature during testing. The design employs a heat flux meter to measure local fouling factors and calorimetric measurements to simultaneously determine average values. Laboratory tests have been carried out using natural gas combustion products doped with slaked lime to serve as the foulant. Local and average fouling factors were obtained over a range of parameters including: inside wall temperature, 270 to 1500°F; gas temperature, 745 to 2214°F; heat flux, 3440 to 40,800 Btu/hr-ft^2; and gas velocity, 9.91 to 27.7 ft/sec. Results obtained confirm that the probe is capable of determining local and average gas-side fouling factors under laboratory conditions.

46044 **(NEI-DK—38) Coal-fueled boilers with a travelling-grate stoker.** Hedegaard Madsen, O. (Danmarks Tekniske Hoejskole, Copenhagen. Lab. for Varme- og Klimateknik). Mar 1987. 302p. (In Danish). NTIS (US Sales Only), PC A14/MF A01. File Number DE87752862.

The numcerical model is based on fundamental chemical and physical processes in coal combustion on grate stokers. Combustion of coal in thin beds are considered as several succession processes: drying, ignition, devolatilization, combustion and gasification. Each process will be treated as a closed system, where the molar flow rate is calculated by the law of mass conservation. The temperature of gas leaving the fuel bed is calculated from the heat balance in the reactor. Temperature is here specified indirectly by the change in enthalpy. The heat transfer in the combustion chamber is described with an one dimensional zone model. The mathematical procedure is generally similar to Hottel's zone model. The combustion chamber is divided into 6 gas zones and 36 surfaces. In this way the chamber is put together by a plug-flow model. The gas temperature for each zone is calculated by the heat balance. In the final model, heat transfer is specified as heat transfer by convection and heat transfer by radiation. The latter term includes gas and particle radiation as in luminous flames. The two sub-models were combined and the final model was used in a sensitivity analysis. In order to compare the model and a practical combustor system, a measurement program on a 5MW chain-grate stoker fired furnace was carried out. (EG). EFP-84; 58 refs.

46045 **(NP—7770268) High-efficiency gas boilers. Edition 1986/1987. A new generation of economical heat-generating devices.** (Ruhrgas A.G., Essen (Germany, F.R.)). 1987. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87770268.

During recent years numerous techniques and products have been developed which contribute to economical energy utilization. The redesigning of boilers including their control devices belongs to the economically most interesting measures for energy conservation. The publication informs on the current state of boiler efficiency with added hints regarding economic efficiency and the conditions for placing and installing heat generators. It explains in detail the principle of boiler efficiency utilization (factors of influence, mode of operation, marginal conditions of use, advantages specific to natural gas), and techniques for utilizing boiler efficiency (types of heat exchangers, combustion techniques and construction principles, atmospheric combustion, combustion by burners fitted with a blower, pulsed combustion using a pulsation burner). Furthermore practical hints are given regarding the installation and use of equipment and regarding guidelines and recommendations for placing and installation. Flueing is also described (flue gas pipes, moisture-resistant chimneys, disposal and neutralization of condensate). The paper concludes with the report of practical experience and recommendations and deals with economic efficiency. (HWJ).

46046 **Feasibility test of a low emissions topping combustor for fluidized bed applications.** Pillsbury, P.W.; Garland, R.V. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-272.

Combined cycles utilizing fluidized bed combustors, whether they be atmospheric or pressurized, are temperature limited. In order to capture sulfur effectively, bed operating temperature and, therefore, the gas turbine inlet temperature is limited to about 1600°F(1144 K) in atmospheric beds and about 1700°F (1200 K) in pressurized beds as reported in DOE/METC/SP-185 (1980). In some applications, material limitations also come into play. While these systems show encouraging economics, they can be enhanced substantially by increasing the turbine inlet temperature. An atmospheric fluidized bed (AFB) example is discussed in this paper. Although emissions control and maintaining acceptable wall temperatures are achieved through the application of the multi-annular swirl burner, the design of such a combustor requires careful consideration of cooling and combustion because of the inherently higher cooling air and combustion air temperatures.

46047 **Temperature effect on particle dynamics and erosion in radial inflow turbine.** Tabakoff, W.; Hamed, A. New York, NY; American Society of Mechanical Engineers (1987). 8p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-123.

This paper presents the results of an investigation of the particle dynamics and the resulting blade erosion in radial inflow turbine rotors. In order to determine the influence of the temperature, the computations were performed for cold and hot inlet flow conditions. The results indicate that the trajectories of these small five micron ash particles are quite sensitive to the flow temperatures. In addition, gas turbines operating under hot flow are subjected to higher local blade erosion rates compared to cold flow conditions.

46048 **Effects of injection on condensation on a film-cooled surface.** Webster, W.P.; Yavuzkurt, S. New York, NY; American Society of Mechanical Engineers (1987). 5p. (CONF-870505—). American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

TP 87-GT-136.

Gas turbine blades have previously been shown to corrode due to condensation of sulfide vapor on a cooled blade surface. In the present paper, water vapor was condensed on a film cooled surface, simulating the condensation of sulfide vapor on a turbine blade. The injection section consisted of one row of holes (inner diameter of 1.0 cm) inclined 30 degrees with the surface and inline with the main turbulent boundary layer flow. Experiments were carried out in a subsonic, zero pressure gradient, turbulent boundary layer with free stream velocities of 10.5, 15.75, and 21.0 m/sec. The results show the existence of a "dryout" region downstream of

each cooling hole. This region was dry while regions between the jets had water on the surface. This dryout region was triangularly shaped, with the apex as much as 30 jet diameters from the downstream edge of the jet. For each Reynolds number the lowest blowing ratio (M=0.4) had the largest dryout region. These results indicate that injection can be used to prevent condensation of corrosive vapors on a film-cooled gas turbine blade.

4220 Underground Engineering

46049 **(SAND—87-0918C) Coring deep into hard rock formations.** Drumheller, D.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-8704110—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013470.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

Scientific investigation of the interior of the earth will ultimately require drilling numerous deep wells. Currently, wells ranging to 50,000 feet in depth are being proposed. With present technology, simply pushing a hole to these depths will be time consuming, difficult, and expensive. As an additional complication, such a drilling project will be considered far from successful unless a large percentage of the drilled formation is recovered in the form of cores. It is an indication of the state of current drilling technology that wells running deeper than 30,000 feet are called ultradeep wells. At present only petroleum drilling equipment can reach these depths, and the rate of core recovery with this equipment is very low. In contrast, the mining industry has developed equipment which can return high percentages of core but only at depths less than 15,000 feet. The methods by which each of these technologies achieves its goals are easily understood, and there are numerous possibilities by which they can be combined to produce a hybrid system capable of meeting current scientific demands. This report will discuss these issues and recommend areas into which technology development should be directed.

4230 Marine Engineering

46050 **(AUC-IBT—8619) Optimal strategy for inspection and repair of structural systems.** Thoft-Christensen, P.; Soerensen, J.D. (Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik). Nov 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752857.

A new strategy for inspection and repair of structural elements and systems is presented. The total cost of inspection and repair is minimized with the constraints that the reliability of elements and-or of the structural system are acceptable. The design variables are the time intervals between inspections and the quality of the inspection. Numerical examples are presented to illustrate the performance of the strategy. The strategy can be used for any engineering system where inspection and repair are required. 11 refs.

46051 **(NEI-DK—35) Conference on safety and pollution safeguards in the development of North West European offshore mineral resources.** (Energiministeriet, Copenhagen (Denmark)). Feb 1987. 118p. (CONF-8611178—Summ.). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752858.

From 5. conference on safety and pollution safeguards; Copenhagen, Denmark (3 Nov 1986).

This Report on the proceedings of the 5th Conference on safety and pollution safeguards in Copenhagen 3, 4 and 5 November 1986 includes a summary record of the discussions at the Conference. The text of the Standards accepted at the Conference are included in appendix seven. For the text of Standards not yet accepted as well as the text of Standards accepted at previous Conferences, reference is made to the summary of proceedings of the fourth Conference in London i October 1984. The Conference agreed to continue the work on safety and pollution safeguards in the development of North West European offshore mineral resources. The Federal Republic of Germany was elected to take over the chairmanship and secretariat and the Netherlands declared its willingness to take over for the subsequent period. All Delegations were in favour of maintaining regular contact between the authorities concerned with offshore safety and to exchange reports and other information thereon. (EG).

4240 Pollution Control Equipment

46052 **(AD-P—005384/3/XAB) Safety considerations for the operation of a thermal-destructor unit for Chemical Surety Materiel 3'x' items.** St, G.W. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Aug 1986. 16p. NTIS, PC A02/MF A01.

This article is from Minutes of the Explosives Safety Seminar (22nd) Held in Anaheim, California on 26-28 August 1986. Volume 2, AD-A181 275, 2013-2028.

This paper outlines the major safety considerations for the operation of a thermal-destructor unit utilized to incinerate 3 x items previously contaminated by Chemical Surety Materiel (CSM). The portions of the operation of the thermal destructor unit which will be evaluated from a safety standpoint in this paper are the receipt/storage of 3 x material, the loading of the firepan, the actual operation of the unit, and the disposition of the 5 x waste and ash. This paper also outlines the engineering controls utilized to ensure that the thermal-destructor unit is operating in compliance with all environmental requirements.

4250 Power Cycles

REFER ALSO TO CITATION(S) 45900

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 46649

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 46069, 46515, 46932

46053 **(BNL—40007) The relativistic heavy ion collider project at Brookhaven.** Reardon, P.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 18p. (CONF-870413—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013300.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

The Relativistic Heavy Ion Collider (RHIC) facility will provide collision energies of 100 GeV/nucleon per beam for heavy ions as massive as gold. RHIC will use the existing Brookhaven AGS and Tandem Van de Graaff as injector. The new accelerator facility, which is a nuclear physics initiative, will utilize the existing facilities of the partially completed CBA project. This report discusses the physics motivation for such a facility, the status of the machine design, R & D work and preparations for experiments at RHIC.

46054 (BNL—52079, pp 139-144) **Design and status of the AGS booster accelerator.** Forsyth, E.B. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

A booster accelerator for the AGS was originally proposed in 1983 as an accumulator for polarized protons and shortly after as a means of also increasing the AGS proton intensity. It was later proposed to also design it for use as a pre-accelerator for heavy ions from the Tandem Van de Graaff so that all ions up to Au (mass 197) could be fully stripped and accelerated in the AGS. Without the Booster the maximum mass than can be directly injected into the AGS is sulfur (mass 32). The Booster is thus an essential component in the chain which will permit the AGS to act as a heavy ion injector into the proposed Relativistic Heavy Ion Collider (RHIC). The diverse requirements for the Booster impose many difficult constraints and compromises on the design. Prior to

the start of construction in November, 1985, a preliminary design had emerged for a fast-cycling machine with a circumference one-quarter of the AGS using a separated function FODO lattice.

46055 **(DOE/ER—0338) Nuclear Physics accelerator facilities.** (USDOE Office of Energy Research, Washington, DC. Nuclear Physics Div.). Sep 1987. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014605.

The Nuclear Physics program requires the existence and effective operation of large and complex accelerator facilities. These facilities provide the variety of projectile beams upon which virtually all experimental nuclear research depends. Their capability determine which experiments can be performed and which cannot. Seven existing accelerator facilities are operated by the Nuclear Physics program as national facilities. These are made available to all the Nation's scientists on the basis of scientific merit and technical feasibility of proposals. The national facilities are the Clinton P. Anderson Meson Physics Facility (LAMPF) at Los Alamos National Laboratory; the Bates Linear Accelerator Center at Massachusetts Institute of Technology; the Bevalac at Lawrence Berkeley Laboratory; the Tandem/AGS Heavy Ion Facility at Brookhaven National Laboratory; the ATLAS facility at Argonne National Laboratory; the 88-Inch Cyclotron at Lawrence Berkeley Laboratory; the Holifield Heavy Ion Research Facility at Oak Ridge National Laboratory. The Nuclear Physics Injector at the Stanford Linear Accelerator Center (SLAC) enables the SLAC facility to provide a limited amount of beam time for nuclear physics research on the same basis as the other national facilities. To complement the national facilities, the Nuclear Physics program supports on-campus accelerators at Duke University, Texas A & M University, the University of Washington, and Yale University. The facility at Duke University, called the Triangle Universities Nuclear Laboratory (TUNL), is jointly staffed by Duke University, North Carolina State University, and the University of North Carolina. These accelerators are operated primarily for the research use of the local university faculty, junior scientists, and graduate students.

46056 **(DOE/ER/40150—6) Superconducting accelerator technology.** Grunder, H.A.; Hartline, B.K. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 26 May 1986. Contract AC05-84ER40150. 17p. (CEBAF-PR—87-018; CONF-860575—63). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012464.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Modern and future accelerators for high energy and nuclear physics rely increasingly on superconducting components to achieve the required magnetic fields and accelerating fields. This paper presents a practical overview of the phenomenon of superconductivity, and describes the design issues and solutions associated with superconducting magnets and superconducting rf acceleration structures. Further development and application of superconducting components promises increased accelerator performance at reduced electric power cost.

46057 **(KEK—86-4) Proceeding of the 11th meeting on linear accelerators.** Nakahara, Kazuo; Anami, Shozo; Takasaki, Eiichi (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Aug 1986. 197p. (In Japanese). (CONF-8609310—). NTIS (US Sales Only), PC A09/MF A01. File Number DE87703005.

From 11. meeting on linear accelerators; Oho, Japan (1 Sep 1986).

The study group on linear accelerators has attained the period of 10 years. The worldwide change of social structure and economical condition during this period affected also linear accelerators. For a while, the new installation of linear accelerators was limited to Japan and China, and the state of standstill continued in Europe and America. Therefore, the large scale projects of electron-positron collision type accelerators started, and LEP of CERN and HERA of DESY in Europe and Linear Collider of SLAC in USA compete the lead together with TRISTAN in Japan. Large electron rings have become the type connecting CW linear accelerators with electromagnets in circular form unlike the conventional type. The developed type of superconducting CW linacs such as CEBAF in USA is planned. In the large accelerators hereafter of CW or pulse type, the RF system of high accuracy and large power output is the key to the success of projects, instead of individual accelerating spaces, high frequency sources, waveguides or controls. When the scale of projects exceeds a certain limit, those cannot be dealt with merely by the experience and means in the past. In this book, the gists of 62 presented papers and invited lectures are collected. (Kako, I.).

46058 **(LA—11048-PR) Progress at LAMPF [Los Alamos Meson Physics Facility]: Progress report, January-December 1986.** Allred, J.C.; Talley, B. (eds.). (Los Alamos National Lab., NM (USA)). May 1987. Contract W-7405-ENG-36. 276p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87014702.

Activities at LAMPF during the year of 1986 are summarized, including brief summaries of experiments in nuclear and particle physics, atomic and molecular physics, materials science, radiation-effects studies, biomedical research and instrumentation, nuclear chemistry, radioisotope production, and theory. The status of an advanced hadron facility currently under study is reported, as well as facility development and accelerator operations. (LEW)

46059 **(LA-UR—87-1242) A high-power rf linear accelerator for FELS [free-electron lasers].** Sheffield, R.L.; Watson, J.M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870622—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011795.

From 19. fluid dynamics, plasma dynamics, and laser conference; Honolulu, HI, USA (8 Jun 1987).

This paper describes the design of a high average current rf linear accelerator suitable for driving short-wavelength free-electron lasers (FEL). It is concluded that the design of a room-temperature rf linear acelerator that can meet the stringent requirements of a high-power short-wavelength FEL appears possible. The accelerator requires the use of an advanced photoelectric injector that is under development; the accelerator components, however, do not require appreciable development. At these large beam currents, low-frequency, large-bore room-temperature cavities can be highly efficient and give all specified performance with minimal risk. 20 refs.

46060 **(LBL—23232) The impact of new computer technology on accelerator control.** Theil, E.; Jacobson, V.; Paxson, V. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 11p. (CONF-870302—247). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014021.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes some recent developments in computing and stresses their application in accelerator control systems. Among the advances that promise to have a significant impact are (1) low cost scientific workstations; (2) the use of "windows", pointing devices and menus in a multi-tasking operating system; (3) high resolution large-screen graphics monitors; (4) new kinds of high bandwidth local area networks. The relevant features are related to a general accelerator control system. For example, this paper examines the implications of a computing environment which permits and encourages graphical manipulation of system components, rather than traditional access through the writing of programs or "canned" access via touch panels.

46061 **(SAND—86-0957) Generating soft x-ray spectra using the SPEED pentaxial diode.** McClenahan, C.R.; Hedemann, M.A.; Beezhold, W.; Counts, N.E.; Lynch, T.P.; Erven, D.J.; Reilly, J.P. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013591.

At 70 kV charge voltage and three anode-cathode (A-K) gaps, 2.0, 2.5, and 3.0 mm, SPEED and the pentaxial diode provide bremsstrahlung-x-ray exposures with peak electron voltages of 350 +- 60, 490 +- 50, and 590 +- 50 kV. At these voltages, the pentax delivers peak dose rates of 0.16 +- 0.06, 0.33 +- 0.08, and 0.57 +- 0.10 . 10^{12} rad(CaF_2)/s, respectively. The 4.4 cm radius opening in a steel clamp ring defines the high-exposure area of 60 cm^2, 2.1 cm

from the tantalum converter. The peak dose occurs at a radius of 1.9 cm, with the axial dose reaching about 80% of the peak. The dose falls to about 70% of peak at 3.8 cm radius. We used the normal pentaxial diode hardware and charged the SPEED Marx generator to 70 kV instead of the normal 90 or 95 kV. A 30 cm diameter and 30 cm deep re-entrant bellows on the vacuum chamber contains the exposure area and maintains a normal atmosphere around the test object. Thermoluminescent dosimeters (TLDs) measured the dose to CaF_2, and silicon PIN diodes measured the radiation pulse width.

46062 **(SAND—87-0082C) The Hermes-III Program.** Ramirez, J.J.; Prestwich, K.R.; Burgess, E.L.; Furaus, J.P.; Hamil, R.A.; Johnson, D.L.; Sanford, T.L.; Seamons, L.O.; Schneider, L.X.; Zawadzkas, G.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870656—37). NTIS, PC A02. File Number DE87012132.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Hermes III is a new gamma ray simulator being built at Sandia National Laboratories as part of the Simulation Technology Laboratory (STL). It will deliver a 20-ns FWHM, 20-ns 10% to 90% rise time, radiation pulse with a peak dose rate of 5 x 10^{12} rad(Si)/sec over a cylindrical volume with a 500-cm^2 front surface area and 15 cm long. The radiation pulse will be uniform within a factor of two across the front surface and within a factor of four anywhere within the volume. The minimum dose rate will be 2.5 x 10^{12} rad(Si)/sec within this volume. The overall configuration of the Hermes-III accelerator is presented together with a discussion of the requirements for the individual components. A brief summary of the subsystems performance obtained to date is also presented. 20 refs., 11 figs.

46063 **(SAND—87-0129C) Saturn: A large area x-ray simulation accelerator.** Bloomquist, D.D.; Stinnett, R.W.; McDaniel, D.H.; Lee, J.R.; Sharpe, A.W.; Halbleib, J.A.; Schlitt, L.G.; Spence, P.W.; Corcoran, P. (Sandia National Labs., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-870656—39). NTIS, PC A02. File Number DE87012021.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

Saturn is the result of a major metamorphosis of the Particle Beam Fusion Accelerator-I (PBFA-I) from an ICF research facility to the large-area x-ray source of the Simulation Technology Laboratory (STL) project. Renamed Saturn, for its unique multiple-ring diode design, the facility is designed to take advantage of the numerous advances in pulsed power technology made by the ICF program in recent years and much of the existing PBFA-I support system. Saturn will include significant upgrades in the energy storage and pulse-forming sections. The 36 magnetically insulated transmission lines (MITLs) that provided power flow to the ion diode of PBFA-I were replaced by a system of vertical triplate water transmission lines. These lines are connected to three horizontal triplate disks in a water convolute section. Power will flow through an insulator stack into radial MITLs that drive the three-ring diode. Saturn is designed to operate with a maximum of 750 kJ coupled to the three-ring e-beam diode with a peak power of 25 TW to provide an x-ray exposure capability of 5 x 10^{12} rads/s (Si) and 5 cal/g (Au) over 500 cm^2.

46064 **(SLAC-PUB—4351) Linear collider approach to a B anti B factory.** Wilson, P.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC03-76SF00515. 8p. (CONF-870170—4). NTIS, PC A02. File Number DE87013588.

From Workshop on a linear-collider B anti B factory; Los Angeles, CA, USA (26 Jan 1987).

In this paper we consider the basic design expression and principal design constraints for a linear collider suitable for a B anti-B factory: Energy $\approx$10 GeV, luminosity 10^{33}-10^{34} $cm^{-2}s^{-1}$, energy resolution $\approx 10^{-2}$. The design of room temperature linear colliders for a B factory is discussed. In such colliders, the rf energy stored in the linac structure is thrown away after each linac pulse. Linear colliders using superconducting rf cavities are considered. Some brief conclusions are presented.

46065 **Accelerator technology.** Edwards, D.A. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 59-66 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

This article is a brief review of the state of accelerator technology and construction as it applies to High Energy Physics. It is divided into four parts. First, the author looks at those facilities that are being commissioned, namely, TRISTAN, the SLC, and Tevatron I. Then, he summarizes the facilities that are being built, LEP, HERA, and UNK, followed by those that are in the proposal stage, the SSC, LHC, and RHIC. Finally he comments on the future and the great interest in linear colliders as a subject of advanced accelerator R and D.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 46009, 46088, 46099, 46426

46066 **(DOE/ER/40315—138) Field mapping of M1 magnet using GFUN3D magnet design program.** XiaYi. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1986. Contract FG02-87ER40315. 22p. NTIS, PC A02. File Number DE87009765.

Using simulation data from GFUN3D, two look-up tables for the M1 magnet, and a function FIELD(x,y,z) which gives the field values at point (x,y,z) have been obtained. The use of each is described in this report. A result of using the function Field(x,y,z) is shown.

46067 **(LBL—23240) Bevalac external beamline optics.** Kalnins, J.G.; Krebs, G.F.; Tekawa, M.M.; Alonso, J.R. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 139p. NTIS, PC A07/MF A01. File Number DE87013968.

This handbook is intended as an aid for tuning the external particle beam (EPB) lines at the Lawrence Berkeley Laboratory's Bevalac. The information contained within will be useful to the Bevalac's Main Control Room and experimenters alike. First, some general information is given concerning the EPB lines and beam optics. Next, each beam line is described in detail: schematics of the beam line components are shown, all the variables required to run a beam transport program are presented, beam envelopes are given with wire chamber pictures and magnet currents, focal points and magnifications. Some preliminary scaling factors are then presented which should aid in choosing a given EPB magnet's current for a given central Bevalac field. Finally, some tuning hints are suggested.

46068 **(LBL—23484) Summary of Working Group on Storage Ring Collective Effects.** Zisman, M.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 16p. (CONF-8703149—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012890.

From Workshop on low emittance beams; Upton, NY, USA (1 Mar 1987).

The purposes of this Workshop were to investigate the techniques available for the production of very low emittance electron beams, to explore the limitations of these techniques, and to consider new possibilities that might improve the present situation. Two uses for these low emittance beams are of interest here: to serve for a high energy linear collider, which requires very small beam sizes to achieve a suitable value for the luminosity; and to serve for a free-electron laser (FEL) in the short wavelength - say 40 A - regime, which requires both small transverse beam dimensions and a very low longitudinal emittance. This paper contains a brief summary of the main topics discussed by the Working Group on Stor-

age Ring Collective Effects. In the case of the linear collider application, the use of a damping ring (DR) to reduce, by radiation damping, the emittance of an intermediate energy linac beam prior to its subsequent injection into the remaining high energy linac is considered. For FEL use, a high-gain device with a storage ring to damp the beam periodically between passages through a bypass section containing the long FEL undulator is considered. Such designs - at a longer wavelength of 400 A - are already available, but the shorter wavelength of interest here is much more of a challenge.

46069 **(SLAC-PUB—4249) Application of online modeling to the operation of SLC.** Woodley, M.D.; Sanchez-Chopitea, L.; Shoaee, H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 8p. (CONF-870302—245). NTIS, PC A02. File Number DE87013583.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Online computer models of first order beam optics have been developed for the commissioning, control and operation of the entire SLC including Damping Rings, Linac, Positron Return Line and Collider Arcs. A generalized online environment utilizing these models provides the capability for interactive selection of a desired optics configuration and for the study of its properties. Automated procedures have been developed which calculate and load beamline component set-points and which can scale magnet strengths to achieve desired beam properties for any Linac energy profile. Graphic displays facilitate comparison of design, desired and actual optical characteristics of the beamlines. Measured beam properties, such as beam emittance and dispersion, can be incorporated interactively into the models and used for beamline matching and optimization of injection and extraction efficiencies and beam transmission. The online optics modeling facility also serves as the foundation for many model-driven applications such as autosteering, calculation of beam launch parameters, emittance measurement and dispersion correction.

46070 **(SLAC-PUB—4293) The nature of beamstrahlung.** Chen, P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1987. Contract AC03-76SF00515. 10p. (CONF-870180—1-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012837.

From Workshop on physics at future accelerators; LaThuile, Italy (7 Jan 1987).

The physical nature of beamstrahlung during beam-beam interaction in linear colliders is reviewed. We first make the distinction between a dense beam and a dilute beam. We then review the characteristics of synchrotron radiation (SR) and bremsstrahlung, and argue that for a wide range of beam parameters beamstrahlung is SR in nature, even if the beam is dilute. Some issues concerning the specific conditions in beamstrahlung as SR are then discussed. Finally we suggest that in order to suppress beamstrahlung energy loss and to improve energy resolution, it is desirable to partition a bunch into a train of bunchlets, where the length of each bunchlet is shorter than the SR convergence length.

46071 **(SLAC-PUB—4364) High gradient superconducting quadrupoles.** Lundy, R.A.; Brown, B.C.; Carson, J.A.; Fisk, H.E.; Hanft, R.H.; Mantsch, P.M.; McInturff, A.D.; Remsbottom, R.H. (Fermi National Accelerator Lab., Batavia, IL (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1987. Contract AC03-76SF00515. 3p. (CONF-850504—316). NTIS, PC A02. File Number DE87013590.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Prototype superconducting quadrupoles with a 5 cm aperture and gradient of 16 kG/cm have been built and tested as candidate magnets for the final focus at SLC. The magnets are made from NbTi Tevatron style cable with 10 inner and 14 outer turns per quadrant. Quench performance and multipole data are presented. Design and data for a low current, high gradient quadrupole, similar in cross section but wound with a cable consisting of five insulated conductors are also discussed.

46072 **(UCRL—96843) Particle in cell simulations of disruption.** Fawley, W.M.; Lee, E.P. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-8706147—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013784.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

An improved numerical particle simulation code has been developed to study the electrodynamical interaction of colliding electron and positron beams. Contrary to previously reported work (which was in error due to a coding mistake), it is found that the maximum enhancement in luminosity due to the mutual pinch effect can exceed a factor of 6 for beams with Gaussian radial profiles and approaches 5 for uniform profiles. These new results are in much better agreement with those originally found by R. Hollebeek.

46073 **Cooled ion beams for physics experiments.** Mills, F.E. (Fermi National Accelerator Lab., Batavia, IL). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 38-42(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Beam cooling methods developed for high energy colliders of protons and antiprotons are now finding application as media for experimentation in Nuclear and Atomic Physics. Two principal methods have been employed, stochastic cooling and electron cooling. The physics of these methods, and their ranges of applicability are discussed.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 46009, 46102

46074 **(AD-A—181469/8/XAB) Pulsed-power equipment for university accelerator-technology program. Final report.** Humphries, S. (New Mexico Univ., Albuquerque (USA). Inst. for Accelerator and Plasma Beam Technology). 1987. 40p. NTIS, PC A03/MF A01.

Purchase was made of necessary equipment for the construction of a high-current betatron experiment. The purchase included ferrite isolation cones, silicon steel isolation cones, HV constant-current power supplies, and HV unregulated power supplies; a paper describing use of this equipment is attached. Generation and propagation of high-brightness electron beams from a magnetically crowbarred injector were studied. Tests of a 300-keV electrostatic electron beam injector with a magnetic crowbar switch are described. The saturable-ferrite-core switch allows generation of a constant-voltage, 80 ns pulse directly from a Marx generator. Inductive isolation in the switch permits direct access to the high-voltage electrode for thermionic or active plasma cathode experiments. The pulse modulator can drive a 1.5-kA load. A high-brightness 290-A beam from a felt plasma-emission cathode was extracted and propagated in vacuum. Because of the reliability of the magnetic-crowbar switch, more than 500 shots were accumulated on the cathode at over 1 kA/2 sq cm with no degradation of the output.

46075 **(BNL—39920) Replaceable Be and Al windows for x-ray beam lines.** Oversluizen, T.; Stefan, P.M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 20p. (CONF-870610—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012118.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

Construction details and results of on-going performance tests are presented for two ultra-high vacuum compatible, free-convection cooled window assemblies in which the window disk is easily replaceable. In the Be window assembly, an 0.25 mm thick Be disk, 38 mm in diameter is sealed into a stainless steel adapter flange using 0.5 mm diameter pure Al wire. The assembly is leak tight to better than 1×10^{-10} atm cm^3/sec before and after multiple bakeouts to 250°C. However, an unexplained temperature-dependent He leak, with a maximum magnitude in the low 10^{-10} atm cm^3/sec range at 250°C, appears during bakeout. Possible causes for this leak are discussed. In the Al window assembly, a 25 μm thick Al

disc, 60 mm in diameter acts as the sealing medium as well as the window material over a 10 mm by 50 mm opening. This assembly remains leak tight to better than 1 x 10^{-10} atm cm^3/sec throughout multiple bakeouts to 150°C and has been successfully tested in white and monochromatic beam lines at the NSLS x-ray ring. 25 refs.

46076 **(BNL—39976) Tandem injected relativistic heavy ion facility at Brookhaven: Present and future.** Thieberger, P.; Barton, D.S.; Benjamin, J.; Chasman, C.; Foelsche, H.; Wegner, H.E. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 28p. (CONF-870498—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012872.

From 7. tandem conference; Berlin, F.R. Germany (6 Apr 1987).

The Brookhaven Tandem Facility has been recently joined to the Alternating Gradient Synchrotron (AGS) by means of an ≈680 meter long heavy ion transfer line. The design and construction of this line are described as well as the Tandem and AGS modifications which made it possible to initiate a relativistic heavy ion research program. Operational experience and performance during the first 14.6 GeV/amu ^{16}O and ^{28}Si runs are reviewed. At present the facility is capable of accelerating ions up to mass ~32. Future developments are described which will lead to the acceleration of heavier ions up to gold, and hopefully to the construction of a relativistic heavy ion collider for the entire mass range at center of mass energies up to 250 GeV per nucleon pair.

46077 **(BNL—40011) Interactive Design of Accelerators (IDA).** Barton, M.Q. (Brookhaven National Lab., Upton, NY (USA)). 30 Jun 1987. Contract AC02-76CH00016. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013298.

IDA is a beam transport line calculation program which runs interactively on an IBM PC computer. It can be used for a large fraction of the usual calculations done for beam transport systems or periods of accelerators or storage rings. Because of the interactive screen editor nature of the data input, this program permits one to rather quickly arrive at general properties of a beam line or an accelerator period.

46078 **(BNL—40031) Magnetic measurements on the X-17 superconducting wiggler.** Decker, G.; Galayda, J. (Brookhaven National Lab., Upton, NY (USA)). Jul 1987. Contract AC02-76CH00016. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013313.

In this report, magnetic field measurements for the superconducting wiggler magnet to be installed in the straight section of the x-ray ring illuminating beam line X17 are described and experimental results are given. A general multiple expansion for the integrated field is derived using the theory of analytic functions. The theory is applied to the measurement of multipole coefficients. Qualitative features of the wiggler's behaviour, such as quenching characteristics and hysteresis, are also discussed. Two different kinds of measurements were made. First, a rotating long coil was used to measure properties of the integrated field, and second, the field variation along the axis of the wiggler was measured using a Hall probe. One of the main purposes of the field measurements was to determine the leading coefficients in a multipole expansion of the the transverse magnetic field, integrated along the axis of the wiggler. With these coefficients available, it is possible to study the effects of the wiggler on the dynamics of the electron beam motion, and in principle to compensate for the effects of the wiggler by using magnetic elements external to the wiggler. 11 figs., 15 tabs.

46079 (BNL—52079, pp 145-150) **Focusing horn upgrades.** Carroll, A.S. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The author examines the possibilities for improving the focusing horns for pion and proton beams at the Brookhaven AGS with the object of increasing neutrino beam intensity. He concludes that present horn systems can be made operational with some repair and that there is room for improvement in neutrino intensity in both Broad Band and Narrow band systems.

46080 (BNL—52079, pp 151-159) **Neutrino flux calculations for the AGS Narrow Band Beam.** Chi, C.; Kondakis, N.; Lee, W.; Rubin, B.; Seto, R.; Stoughton, C.; Tzanakos, G.; O'Brien, E.; O'Halloran, T.; Reardon, K.; Salman, S. (Columbia Univ., NY). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—). Contract AC02-76ER01195.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The authors present results of calculations of nu/sub μ/ fluxes in the AGS neutrino beam with the new dichromatic horn. The wide band beam nu/sub μ/, as well as the nu/sub e/ backgrounds, are discussed. The nu/sub e//nu/sub μ/ ratio is about 8 x 10^{-3}. The possible sources and magnitudes of uncertainties are discussed. Finally, the calculated fluxes are compared with beam measurements.

46081 **(DOE/ER/40150—32) Superconducting radio frequency technology: Expanding the horizons of physics and technology.** Grunder, H.A.; Leemann, C.W.; Sundelin, R.M.; Hartline, B.K. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 16p. (CEBAF-PR—87-023; CONF-8610108—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012466.

From 2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX, USA (23 Oct 1986).

This paper describes a major new technology supporting the further evolution of accelerators: superconducting radio frequency (SRF) technology, which is today on the verge of large-scale application in accelerators. Originally foreseen in the early 1960s as a promising technology, SRF only recently has overcome several technological and practical hurdles. SRF accelerating structures promise low rf losses and high gradients under cw operation. High-quality, intense cw beams can be accelerated without risk of melting the structure and without requiring enormous amounts of input rf power.

46082 **(FNAL-TM—1450) Full length prototype SSC dipole test results.** Strait, J.; Brown, B.C.; Carson, J.; Engler, N.; Fisk, H.E.; Hanft, R.; Koepke, K.; Kuchnir, M.; Larson, E.; Lundy, R. (Fermi National Accelerator Lab., Batavia, IL (USA); Brookhaven National Lab., Upton, NY (USA); Lawrence Berkeley Lab., CA (USA)). 24 Apr 1987. Contract AC02-76CH03000. 8p. (CONF-870983—1). NTIS, PC A02. File Number DE87010299.

From Applied superconductivity conference; Baltimore, MD, USA (28 Sep 1987).

Results are presented from tests of the first full length prototype SSC dipole magnet. The cryogenic behavior of the magnet during a slow cooldown to 4.5K and a slow warmup to room temperature has been measured. Magnetic field quality was measured at currents up to 2000 A. Averaged over the body field all harmonics with the exception of b_2 and b_6 are at or within the tolerances specified by the SSC Central Design Group. (The values of b_2 and b_6 result from known design and construction defects which will be be corrected in later magnets.) Using an NMR probe the average body field strength is measured to be 10.283 G/A with point to point variations on the order of one part in 1000. Data are presented on quench behavior of the magnet up to 3500 A (approximately 55% of full field) including longitudinal and transverse velocities for the first 250 msec of the quench.

46083 **(IFVE-OMVT—86-145) Calculation of precise beam bending magnet for racetrack microtron.** Babayan, A.Z.; Grishin, V.K.; Dajkovskij, A.G.; Ershov, S.Yu.; Ishkhanov, B.S.; Sotnikov, M.A.; Tumanyan, A.R.; Shvedunov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703103.

Results of calculations of 180 deg beam bending magnets (BM) for a racetrack continuous action microtron are presented. The methods for beam bending magnet calculation by means of FEMB12 program package are described. Magnetic field inhomo-

geneity within +-2x10/sup -4/ at the field level of 0.9 T is shown to be reached by means of a shimming gap and shimming. 11 refs.; 8 figs.; 2 tabs.

46084 **(SAND—86-2660C) Design and development of an improved AURORA Blumlein Oil Switch Trigger System.** Warren, F.T. Jr.; Frazier, G.B.; Simmons, D.P.; Seamen, J.F.; Turman, B.N.; Prestwich, K.R. (Physics International Co., San Leandro, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—36). NTIS, PC A02. File Number DE87012131.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

An improved trigger system for the oil switches on the AURORA Blumleins has been designed and studied. The Pulserad 738 Machine has been temporarily disassembled and used to house a trigger system testing facility. The facility consists of a 2-MV Marx charging circuit, a Blumlein pulser and a replica of the AURORA oil switch, and has been used to test oil-switch triggering at the 4- to 6-MV level. The design details of this facility and the jitter performance of various components of the pulser are presented.

46085 **(SAND—87-0114C) Hermes-III prototype cavity tests.** Johnson, D.L.; Ramirez, J.J.; Huddle, C.W.; Denison, G.J.; Franklin, T.L.; Seamons, L.O.; Schlitt, L.; Smith, I. (Sandia National Labs., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). Jun 1987. Contract AC04-76DP00789. 4p. (CONF-870656—42). NTIS, PC A02. File Number DE87012402.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The Hermes-III accelerator has twenty 1-MV, inductively isolated cavities connected in series through a high voltage, magnetically insulated transmission line (MITL) to produce a 20-MV, 800-kA pulse that drives a bremsstrahlung diode. Each cavity is 4 m in diameter and weighs nearly 8000 kg when filled with its insulating transformer oil. Cores of pre-annealed Metglas 2605CO are used to inductively isolate the cavities. Azimuthal transmission lines mix inputs from four pulse-forming lines; this reduces the effect of pule-forming line jitter on the cavity output pulse. A single, prototype cavity has been tested on the System Test Facility (STF). The test results and comparisons with design specifications and circuit simulations are presented.

46086 **(SAND—87-0137C) Proto II triaxial electron beam diode research.** Hedemann, M.A.; Pregenzer, A.L.; Lee, J.R.; Leeper, R.J.; Bailey, J.E.; Gustwiller, J.S.; Spence, P.W.; Kishi, H. (Sandia National Labs., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—43). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012359.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The Proto II accelerator has been modified to provide electron beam diode loads for bremsstrahlung radiation production. Stable, reproducible operation has been established over a voltage range of 0.5 to 1.5 MV with diode power up to 5 TW. The electron beam diode consists of two nested triaxial diodes which operate independently due to transit time isolation of the power flow. Both the current balance and prepulse levels have been found to be critical to the operation of the diodes. Water switching spreads between the 8 modules of up to 15 ns do not impair diode performance. Ion currents due to bipolar flow have been measured and are relatively low, consistent with triaxial diode models. Radiation output has been measured and compared with radiation transport code calculations. At the highest operating voltages, peak dose rates of $>1.2 \times 10^{12}$ rad(Si)/s over >250 cm^2 (2:1 uniformity) are routinely obtained in radiation pulses with a full-width, half-maximum (FWHM) of 22 ns.

46087 **(SAND—87-0848) Portable deaerator for deionized water systems.** Lancaster, K.T. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013843.

The flowing water deaerator systems were designed and built for the TEMPO microwave pulser. The TEMPO program major goals were to build three one-megavolt, rep-rate pulsers capable of providing high power pulsed microwaves for various susceptibility and biological experiments. The TEMPO machine is a transformer driven water dielectric transmission line pulser. The water in the transmission line is required to have high purity and be bubble-free. The purity of the water is maintained by a filtered deionizing system that was supplied by a local vendor. The deaerating system was unique because it was required to be portable and self-contained. The design was based on a very large existing system (RADLAC II) which was not portable. The present system was scaled down to the approximate size of 2 ft x 4 ft x 7 ft high and mounted on a caster-supported frame for portability. Its small size and closed-loop operation allowed it to fit into a transportable subsystem container which housed the water processing and air supply systems. The following report discusses the design, installation, and operation of this flowing water deaerator.

46088 **(SAND—87-1693C) Trajectory vs. PIC methods in diode design.** Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870947—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012135.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

This report discusses an automated method of computing electron trajectories in electron diodes. The advantages of the method are stated to be improved efficiency and lack of noise. Computations using this method compared favorably with older methods. (JDH)

46089 **(SLAC-PUB—4159) A conceptual design of Final Focus Systems for linear colliders.** Brown, K.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC03-76SF00515. 8p. (CONF-8610108—3; CONF-870170—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012840.

From 2. joint US/CERN school on particle accelerators: frontiers of particle beams; South Padre Island, TX, USA (23 Oct 1986).

Linear colliders are a relatively recent development in the evolution of particle accelerators. This report discusses some of the approaches that have been considered for the design of Final Focus Systems to demagnify the beam exiting from a linac to the small size suitable for collisions at the interaction point. The system receiving the most attention is the one adopted for the SLAC Linear Collider. However, the theory and optical techniques discussed should be applicable to the design efforts for future machines.

46090 **(SLAC-PUB—4375) Conventional power sources for colliders.** Allen, M.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1987. Contract AC03-76SF00515. 3p. (CONF-8706147—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014317.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

At SLAC we are developing high peak-power klystrons to explore the limits of use of conventional power sources in future linear colliders. In an experimental tube we have achieved 150 MW at 1 μsec pulse width at 2856 MHz. In production tubes for SLAC Linear Collider (SLC) we routinely achieve 67 MW at 3.5 μsec pulse width and 180 pps. Over 200 of the klystrons are in routine operation in SLC. An experimental klystron at 8.568 GHz is presently under construction with a design objective of 30 MW at 1 μsec. A program is starting on the relativistic klystron whose performance will be analyzed in the exploration of the limits of klystrons at very short pulse widths.

46091 **(UCRL—15929) Studies on temporal field emission from stainless steel surfaces: Final report, April 30, 1987 to June 30, 1987.** (Science Research Corp., Somerville, MA (USA); Lawrence Livermore National Lab., CA (USA)). 30 Jun 1987. Contract W-7405-ENG-48. 35p. (SRL—03-F-1987). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014237.

The Free Electron Laser imposes stringent requirements on the emittance of the drive electron beam. However, constraints on the injector and accelerator sections of the FEL are imposed by maximum allowable electric field stresses which limit the ability to produce low emittance beams. Research presented in this report is an effort to measure the time dependent field emission of electron current from a variety of prepared stainless steel surfaces. Results indicate that the threshold electric field for emission ranged from 75 kV/cm for stainless steel machined to an RMS surface roughness of .000125" to 280 kV/cm for "GREENED" stainless steel. The effect on the field emission threshold due to the presence of a barium oxide evaporation source was also investigated. These experiments more closely represent the conditions present in the injector of an FEL which utilizes a thermionic emitter cathode. A reduction in the emission threshold (230 kV/cm) for the "GREENED" stainless steel surface was observed.

46092 **(UCRL—96384) The Beam Line X NdFe-steel hybrid wiggler for SSRL.** Hoyer, E.; Halbach, K.; Humphries, D.; Marks, S.; Plate, D.; Shuman, D.; Karpenko, V.P.; Kulkarni, S.; Tirsell, K.G. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). 10 Mar 1987. Contract W-7405-ENG-48;AC03-76SF00098. 5p. (CONF-870302—241). NTIS, PC A02. File Number DE87011556.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A wiggler magnet with 15 periods, each 12.85 cm long, which achieves 1.40 T at a 2.1 cm gap (2.26T at 0.8 cm) has been designed and is now in fabrication at LBL. This wiggler will be the radiation source of the high intensity synchrotron radiation beam line for the Beam Line X PRT facility at SSRL. The magnet utilizes Neodymium-Iron (NdFe) material and Vanadium Permendur (steel) in the hybrid configuration to achieve simultaneously a high magnetic field and short period. Magnetic field adjustment is with a driven chain and ball screw drive system. The magnetic structure is external to an s.s. vacuum chamber which has thin walls, 0.76 mm thickness, at each pole tip for higher field operation. Magnetic design, construction details and magnetic measurements are presented.

46093 **(UCRL—96947) Linear emittance damper with megagauss fields.** Barletta, W.A. (Lawrence Livermore National Lab., CA (USA)). 3 Jul 1987. Contract W-7405-ENG-48. 7p. (CONF-8706147—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013562.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

The emittance of the beams in both high energy, electron-positron colliders and synchrotron light sources is limited by collective beam interactions with the structure of the damping (or storage) rings. A novel linear damper offers the possibility of reducing the emittance by another factor of a few. The underlying physical principle is that high energy, high current, low emittance beams can emit copious hard gammas as synchrotron radiation and cool in the presence of megagauss magnetic fields. These fields can be provided by the beam itself in the presence of a low density gas.

46094 **HVEM-tandem accelerator facility at Argonne National Laboratory.** Taylor, A.; Allen, C.W.; Ryan, E.A. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 598-602(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The HVEM-Tandem National User Facility consists of a modified Kratos/AE1 EM7 HVEM with a maximum accelerating voltage of 1.2 MeV, interfaced to both a 2MV National Electrostatics tandem ion accelerator and a 300 kV Texas Nuclear ion accelerator. The latter is being replaced with a 650 kV National Electrostatics accelerator which should be fully operational in FY 1987. These accelerators provide a wide range of ion species with energies from 25 keV to 8 MeV. The combination of HVEM and ion accelerators provides a truly unique capability for ion irradiation/implantation experimentation along with simultaneous microscopy. The HVEM-Tandem Facility currently is employed for a wide range of materials research, including basic in situ studies of mechanical properties, oxidation and hydrogen effects in metals, radiation effects including ion and electron irradiation-induced phase changes and general defect analysis. More than half of these studies are conducted by non-ANL scientists from universities and other national laboratories. Access to the National User Facility is by means of research proposals wich arereviewed by a Steering Committee composed of both Argonne and non-Argonne scientists representing the user community.

46095 **Atomic physics and synchrotron radiation: the production and accumulation of highly charged ions.** Johnson, B.M.; Meron, M.; Agagu, A.; Jones, K.W. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 391-396(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Synchrotron radiation can be used to produce highly-charged ions, and to study photoexcitation and photoionization for ions of virtually any element in the periodic table. To date, with few exceptions, atomic physics studies have been limited to rare gases and a few metal vapors, and to photoexcitation energies in the VUV region of the electromagnetic spectrum. These limitations can now be overcome using photons produced by high-brightness synchrotron storage rings, such as the X-ray ring at the National Synchrotron Light Source (NSLS) at Brookhaven. Furthermore, calculations indicate that irradiation of an ion trap with an intense energetic photon beam will result in a viable source of highly-charged ions that can be given the name PHOBIS: the photon beam ion source. Promising results, which encourage the wider systematic use of synchrotron radiation in atomic physics research, have been obtained in recent experiments on VUV photoemission and the production and storage of multiply-charged ions. An overview of the field, current plans, and future possibilities will be presented.

46096 **Radioactive ion beam research at Lawrence Livermore National Laboratory.** Sale, K.E.; Bauer, R.W.; Boyd, R.N.; Mathews, G.J.; Haight, R.C.; Corn, P.B. (Lawrence Livermore National Lab., CA; Los Alamos National Lab., NM; Ohio State Univ., Columbus). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 490-492(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report UCRL—95451; CONF-861114—14--8.

Several modifications and additions have been made to improve the radioactive beam facility at Livermore with the main aim of measuring the cross section for $^{7}Be(p\gamma)^{8}B$ (which is important in determining the solar neutrino flux) and other reactions of astrophysical interest. The quadrupole sextuplet spectrometer has been upgraded by inserting an electrostatic deflection element near the midpoint and by installing a movable beam stop near the ^{7}Be production target. These changes have allowed an improvement in the purity, and large increase in the intensity, of the ^{7}Be beam. Six large NaI(Tl) detectors and the gas cell from OSU system along with its active and passive shielding have been incorporated into the Lawrence Livermore facilty. True events are to be identified by a multiple coincidence. The first requirement is the detection of a γ-ray from the proton capture $^{7}Be(p,\gamma)^{8}B$. After the candidate capture gamma is observed the ^{8}B decay signature is required. This signature is a positron (from $^{8}B->{}^{8}Be/sup\ */+e^{+}+\nu$) along with the two α's from $^{8}Be->\alpha+\alpha$ observed in a CaF_2 detector into whicn the ^{8}B have implanted. Also a detector telescope inside the

gas cell monitors the incoming ^{7}Be beam. The current status of the ^{7}Be(p,γ)^{8}B measurement is discussed.

46097 **HVEM-tandem accelerator facility at Argonne National Laboratory.** Taylor, A.; Allen, C.W.; Ryan, E.A. (Argonne National Lab., IL). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 598-602(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The HVEM-Tandem National User Facility consists of a modified Kratos/AE1 EM7 HVEM with a maximum accelerating voltage of 1.2 MeV, interfaced to both a 2MV National Electrostatics tandem ion accelerator and a 300 kV Texas Nuclear ion accelerator. The latter is being replaced with a 650 kV National Electrostatics accelerator which should be fully operational in FY 1987. These accelerators provide a wide range of ion species with energies from 25 keV to 8 MeV. The combination of HVEM and ion accelerators provides a truly unique capability for ion irradiation/implantation experimentation along with simultaneous microscopy. The HVEM-Tandem Facility currently is employed for a wide range of materials research, including basic in situ studies of mechanical properties, oxidation and hydrogen effects in metals, radiation effects including ion and electron irradiation-induced phase changes and general defect analysis. More than half of these studies are conducted by non-ANL scientists from universities and other national laboratories. Access to the National User Facility is by means of research proposals wich arerevieweed by a Steering Committee composed of both Argonne and non-Argonne scientists representing the user community.

4304 Storage Rings

REFER ALSO TO CITATION(S) 46068

46098 **(BNL—40055) Compact electron storage rings.** Williams, G.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 15p. (CONF-870610—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013301.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

There have been many recent developments in the area of compact storage rings. Such rings would have critical wavelengths of typically 10 A, achieved with beam energies of several hundreds of MeV and superconducting dipole fields of around 5 Tesla. Although the primary motivation for progress in this area is that of commercial x-ray lithography, such sources might be an attractive source for college campuses to operate. They would be useful for many programs in materials science, solid state, x-ray microscopy and other biological areas. We discuss the properties of such sources and review developments around the world, primarily in the USA, japan and W. Germany.

46099 **(SLAC-PUB—4366) Luminosity and tune shift in e^+e^- storage rings.** Brown, K.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1987. Contract AC03-76SF00515. 4p. (CONF-870170—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014314.

From Workshop on a linear-collider B anti B factory; Los Angeles, CA, USA (26 Jan 1987).

Luminosity and tune shift have been the subject of numerous papers and talks since the invention of electron-positron storage rings. This paper derives an equation for luminosity and one for the linear tune shift based upon two simple assumptions. The first assumption is that the storage ring be designed such that the linear tune shifts in the two transverse planes, x and y, are equal; i.e., that Δnu/sub x/ = Δnu/sub y/. The second assumption is that the maximum acceptable disruption angle, θ/sub D/, of the colliding beams is approximately equal to the "natural" beam spread, θ/sub B/, of the stored colliding beams at the interaction point. First derived is the results for round beams having transverse gaussian distribution functions and then extend the derivation to beams having elliptical cross sections. Then compared are theoretical results with the observed results in several operating machines and with the "design" parameters of three new machines; namely KEK, BEPC, and LEP.

46100 **Design considerations for a combined synchrotron light source and heavy-ion storage ring atomic physics facility.** Jones, K.W.; Johnson, B.M.; Meron, M.; Lee, Y.Y.; Thieberger, P.; Thomlinson, W.C. (Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 381-390(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An atomic physics facility (APF) based on the combination of photons produced by a synchrotron light source with heavy ions in a storage ring will open the way to the study of ionic states of almost all elements. The design considerations for such a facility are discussed in terms of the use of synchrotron radiation for photoexcitation and ionization experiments. Design considerations for an APF are given in terms of the accelerator facilities presently available at BNL which include the National Synchrotron Light Source and Tandem Van de Graaff Laboratory. The results show that the concept is valid and therefore that implementation would result in entirely new capabilities for the study of multiply-ionized atoms.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 45170, 45513, 45856, 46135, 46294, 46429, 46517, 46644, 46649, 46712, 46730

46101 **(AD-A—181789/9/XAB) Performance characteristics of a high-level solid-state personnel dosimetry system in pulsed radiation environments.** Swaja, R.E.; Oyan, R.; Sims, C.S.; Dooley, M.A. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 8p. (AFRRI-SR—86-50). NTIS, PC A02/MF A01.

Pub. in Radiation Protection Dosimetry, Vol. 15, No. 2, 109-115(1986).

The Health Physics Research Reactor at Oak Ridge National Laboratory was used to evaluate performance characteristics of a high-level, solid-state, personnel-dosimetry system developed for the US Army for the rapid measurement of total(gamma plus neutron) radiation doses to soldiers in locations where tactical nuclear weapons could be used. The gamma-sensitive element of the dosemeter consists of a silver-activated phosphate glass and the neutron detector is a silicon diode. Areas considered in this evaluation included pre-irradiation dose indication: accuracy and precision of gamma, neutron, and total dose measurements; time dependence; and temperature effects. Study results indicate that for doses above about 0.4 Gy, the system can provide rapid and accurate dose estimates within accuracy limits specified by several international regulatory and standards agencies for criticality accident dosimetry. However, theoretical and observed lower limits of detection for this system are somewhat higher than the 0.25 Gy minimum dose of interest for general-accident dosimetry.

46102 **(BNL—40053) Development of an x-ray fluorescence microprobe at the National Synchrotron Light Source, Brookhaven National Laboratory: Early results: Comparison with data from other techniques.** Smith, J.V.; Rivers, M.L.; Sutton, S.R.; Jones, K.W.; Hanson, A.L.; Gordon, B.M. (Brookhaven National Lab., Upton, NY (USA); Chicago Univ., IL (USA)). 1986. Contract AC02-76CH00016. 11p. (CONF-8608121—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013302.

From 11. international congress on X-ray optics and microanalysis; London, Canada (4 Aug 1986).

Theoretical predictions for the detection levels in x-ray fluorescence analysis with a synchrotron storage ring are being achieved experimentally at several laboratories. This paper is deliberately restricted to the state of development of the Brookhaven National Laboratory/University of Chicago instruments. Analyses at the parts per million (ppM) level are being made using white light apertured to 20 μm and an energy dispersive system. This system is particularly useful for elements with Z > 20 in materials

dominated by elements with Z < 20. Diffraction causes an interference for crystalline materials. Development of a focusing microprobe for tunable monochromatic x-rays and a wavelength dispersive spectrometer (WDS) is delayed by problems in shaping an 8:1 focusing mirror to the required accuracy. Reconnaissance analyses with a wiggler source on the CHESS synchrotron have been made in the K spectrum up to Z = 80.

46103 **(BNL—40084) Multilayer monochromators for neutron spectrometers.** Saxena, A.M.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-8708117—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014291.

From Neutron scattering symposium on advances and applications; Sydney, Australia (8 Aug 1987).

Multilayer devices have proved to be useful in improving the characteristics of small angle neutron spectrometers. Multilayer monochromators have been fabricated, with d-spacings in the 57 to 200 A range, that have reflectivities greater than 0.95. Multilayer polarizers made of Fe-Ge have similar d-spacings and reflectivities, and polarize the neutron beam with an efficiency approaching unity. It has been shown that the use of neutron guidetubes made of multilayer supermirrors will result in a higher neutron flux at the sample. Present efforts in the fabrication of multilayers are directed towards the following: (1) decreasing the d-spacing while maintaining a high reflectivity, (2) depositing multiple d-spacing monochromators for optimizing the performance of a spectrometer, (3) design and development of supermirror guidetubes. Deposition of such devices requires a precise control on the thickness of each film, with the possibility of changing thicknesses in a predetermined manner. Comparison of theoretical calculations with the diffraction characteristics of multilayers has shown that actual multilayers have significant thickness disorder, which results in a degradation of reflection properties. The number of bilayers required to make a high-reflectivity multilayer increases rapidly with decreasing d-spacing. Even a small amount of random thickness disorder will have a cumulative effect, and this may impose a lower limit on the d-spacing of a useful multilayer.

46104 **(BNL—40123) An approximately 4π tracking magnetic spectrometer for RHIC.** (Brookhaven National Lab., Upton, NY (USA); City Univ. of New York, NY (USA)). 1987. Contract AC02-76CH00016;AC02-83ER40107. 22p. (CONF-870543—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014286.

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

A tracking magnetic spectrometer based on large Time Projection Chambers (TPC) is proposed to measure the momentum of charged particles emerging from the RHIC beam pipe at angles larger than four degrees and to identify the particle type for those beyond fifteen degrees with momenta up to 700 MeV/c, which is a large fraction of the final charged particles emitted by a low rapidity quark-gluon plasma.

46105 (BNL—52079, pp 161-168) **Liquid argon time projection chamber.** Buehler, G. (Univ. of California, Irvine). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Time projection chambers (TPC) with liquid sensitive media are considered to be promising tools for future neutrino experiments. In the first part of this presentation the potentials of liquid TPC's are briefly summarized with emphasis given to the liquid argon chamber. The progress in developing a 10^4 kg (10 ton) device at University of California at Irvine and the current status of the project are outlined in the second part.

46106 (BNL—52079, pp 169-176) **Physics calibration of the Soudan II nucleon decay experiment using BNL neutrinos.** Mann, W.A. (Tufts Univ., Medford, MA). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

For neutrino energies near the nucleon mass, the shape of the E/sub nu/ flux spectrum from the wide-band beam at the AGS resembles the shape of flux spectrum from atmospheric neutrinos. An opportunity is thus presented to measure the extent to which neutrino events can mimic decaying nucleons in a proton decay search, provided that a detector representative of the underground experiment can be operated in the Brookhaven beam. This crucial calibration measurement is feasible for the Soudan II experiment, wherein a 1.1 kiloton detector is assembled out of standardized five-ton tracking calorimeter modules. Each module provides fine-grained dE/dx/ sampling with independent signal readout. Details concerning neutrino exposures using a cluster of these modules is presented.

46107 (BNL—52079, pp 177-184) **Sudbury neutrino observatory.** Doe, P.J. (Univ. of California, Irvine). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

A full engineering design study is underway for an observatory based on a 1000 ton heavy water Cerenkov detector located deep underground. The principal goal of the observatory is to measure the flux, spectrum and direction of the ^{8}B solar neutrino. The detector is also sensitive to the flux of muon or tau neutrinos which may arise from oscillation of the ^{8}B neutrinos. An overview of the detector and its capabilities is given.

46108 **(CONF-871005—1) A portable measurement system for subcriticality measurements by the CF-source-driven neutron noise analysis method.** Mihalczo, J.T.; Ragan, G.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008592.

From Nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A portable system has been assembled that is capable of measuring the subcriticality of fissile materials using the ^{252}CF-source-driven neutron noise analysis method. The measurement system consists of a parallel-plate ionization chamber containing ^{252}CF, two ^{3}He proportional counters with their associated electronics, and a small computer containing anti-aliasing filters and A/D convertors. The system Fourier analyzes the digitized data and forms the appropriate auto and cross-power spectral densities. These spectra are used to form a ratio of spectral densities, $G_{12}G_{13}/G_{11}G_{23}$, where 1 refers to the ionization chamber, and 2 and 3 refer to the ^{3}He counters, from which subcriticality can be determined. The chamber and detectors are located appropriately near the fissile material. The system is capable of sampling signals at rates of up to 80 kHz and processing these data at rates of 2 kHz to form the appropriate spectra. The presently configured system is a two-channel system, hence the measurement of G_{12}, G_{13}, and G_{23} must be done sequentially before the ratio of spectral densities is obtained. Future improvements of the system will allow simultaneous measurement of all spectra and will further reduce size, thereby enhancing portability. This measurement system can provide reliable, cost effective, and convenient determination of the subcriticality of a wide variety of fissile materials and moderators.

46109 **(DOE/ER/03130—29) Design of phonon detectors for neutrinos.** Maris, H.J. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1986. Contract AC02-76ER03130. 4p. (CONF-860611—1; COO—3130TC-29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014479.

From 5. international conference on phonon scattering in condensed matter; Urbana, IL, USA (2 Jun 1986).

Several alternative neutrino detection schemes are described briefly and compared. It is suggested that a ballistic-phonon experiment might be promising. In such an experiment the amplitude received at a bolometer would depend on the distance it is from the neutrino event, and also on the direction because of phonon focusing, so several bolometers suggested to locate the event position from the difference in arrival times. The design of such an experiment is discussed assuming the phonons are detected by conventional superconducting bolometers. Determination of the direction of neutrino flux would be obtained from a study of the distribution

of direction of the tracks of recoiling electrons or nuclei. The problem of smearing out the effective source over a distance of approximately a mean free path is addressed, and the need for high-resolution phonon focusing studies is expressed. (LEW)

46110 **(DOE/ER/03130—32) Superfluid ^{4}He as a solar neutrino detector.** Lanou, R.E.; Maris, H.J.; Seidel, G.M. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1987. Contract AC02-76ER03130. 8p. (CONF-8703121—5; COO—3130TC-32). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014477.

From Telemark IV - neutrino mass and neutrino astrophysics; Ashland, WI, USA (16 Mar 1987).

Neutrinos produced in the sun provide a source of unique value in studying neutrino properties. A severe challenge is presented to find suitable detection techniques over the range of neutrino energies involved in solar processes. In particular those produced in the reaction least sensitive to details of the solar model present the most difficulty. We suggest a new technique which shows promise to overcome these difficulties. It is based upon use of superfluid ^{4}He as the detecting medium and utilizes unusual kinetics of rotons at low temperatures. 15 refs., 2 figs.

46111 **(DOE/ER/03130—33) The use of rotons in liquid helium to detect neutrinos.** Lanou, R.E.; Maris, H.J.; Seidel, G.M. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1987. Contract AC02-76ER03130. 8p. (CONF-8703176—1; COO—3130TC-33). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014476.

From Workshop on low temperature detectors for low energy neutrinos and dark matter; Munich, F.R. Germany (12 Mar 1987).

A new technique for measuring calorimetrically the energy spectrum of recoil electrons from the elastic scattering of neutrinos is discussed. The method involves the use of superfluid helium at low temperatures.

46112 **(DOE/EV/10673—T5) Neutron detection using superheated drops: [Final] technical report No. 2, covering the period 1 November 1984-1 July 1986.** Apfel, R.E. (Yale Univ., New Haven, CT (USA). Dept. of Mechanical Engineering). 1 Jun 1987. Contract AC02-81EV10673. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012996.

This Technical/Progress Report traces four areas of significant progress made in the past year: Measurements of the sensitivity of neutron detectors based on superheated drops (SDD's) with monoenergetic and broad spectrum neutron sources (moderated Cf) ranging in energy from thermal to 14 MeV; Theoretical formulation and analysis allowing for the prediction of the sensitivity of various SDD's, and comparison with experiment; full numerical theory for the nucleation process, which sheds light on the fundamental radiation-matter interaction; and redesign of intrumentation both for ease of use and to make more immune to false alarms, even with rough handling.

46113 **(INIS-mf—10656) Prototype study on the detection of neutrino-induced event signatures in the range of 5-50 MeV in the large scintillation detector KARMEN 1.** Reuscher, M. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). 11 Jul 1986. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752465.

In the framework of the KARMEN project at the pulsed spallation neutron source ISIS of the Rutherford Appleton Laboratory an optically segmented 53 t liquid scintillation detector is constructed. By it reactions are observed which are induced by the beam dump neutrinos of ISIS with energies up to about 50 MeV. Possible oscillations of the kind anti ν/sub μ/ -> anti ν/sub e/ and ν/sub μ/ -> ν/sub e/ shall be studied. The sensitivity of the KARMEN experiment to these oscillations was estimated. Thereby assumptions on the systematic errors and the background to be expected were necessary. For the oscillations anti ν/sub μ/ -> anti ν/sub e/ sensitivity limits (90% limit) result: Δm/sup 2/=0.05 eV/sup 2/ at maximal mixing and sin/sup 2/2Θ=0.002 at large Δm/sup 2/. To the oscillations ν/sub μ/ -> ν/sub e/ the experiment is not so sensitive but because of the time structure of the ν source this oscillation can be measured freely from normalization assumptions. On a prototype detector which comprises 1000 l scintillator and is divided by nine optical segments measurements with cosmic radiation were performed in order to determine the energy, time, and spatial resolution. Thereby the energy range from 7 to about 40 MeV per module was scanned. The light yield was determined both in dependence on the energy and on the position for all segments and thereby for both sides of each detector module and as sum of both sides. The light yield is proportional to the deposed energy. The single energy resolution of the prototype detector is position dependent and amounts at 28 MeV mean deposed energy maximally to 15%, the sum energy resolution lies at 9% and is in good approximation position independent.

46114 (INIS-mf—10946, pp 28-33) **Intrinsic sensitivity of LiF, CaF/sub 2/:Dy and CaF/sub 2/:Tm crystals exposed to uv radiation and their photo-transferred thermoluminescence.** Ben-Shachar, B.; Laichter, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46115 (INIS-mf—10946, pp 36-42) **Fast calibration of a flat 3 x 3 inches NaI(T1) detector for gamma counting of various geometries, by use of a point-source calibration curve.** Levinson, S.; Shani, G.; Bergman, S.; Gilad, Y.; German, U. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46116 **(JINR—13-85-933) One-dimensional positron-sensitive detector for X-ray studies at superhigh pressures.** Aleksandrov, I.V.; Zisman, A.N.; Stishov, S.M.; Zanevskij, Yu.V.; Movchan, S.A.; Peshekhonov, V.D.; Chan Dyk Tkhan'. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1985. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703111.

A one-dimensional detector based on the proportional chamber with recording efficiency — 65% for MoK/sub L/ line and spatial resolution of 170 μm is developed for X-ray diffraction investigations at super-high pressures carried out by means of micropresses with diamond envils. The chamber anode is made of 15 μm wires with 3 mm step. The input box window, made of vacuum-dense beryllium of 1 mm in thick, and the wire delay line (DL), designed for coordinate data reading, serve as a cathode being 5 mm apart from the anode plane. Operating gas is a mixture of xenon and 10% methane under pressure 5 atm. per sensitive volume is 10x10x110 mm/sup 3/. Application of the linear position-sensitive detector for X-ray investigations at superhigh pressures is shown to allow one to obtain approximately tenfold increase of aperture ratio in comparison with photographic method with high resolution conservation, which is not achievable when using germanium and silicon semiconductor detectors. 7 refs.; 6 figs.

46117 **(SAND—87-1257C) X-ray photoelectric detectors with conical cathodes: Sensitivity to beam divergence.** Fehl, D.L.; Dozier, C.M.; Freitag, R.K.; Brown, D.B. (Sandia National Labs., Albuquerque, NM (USA); Naval Research Lab., Washington, DC (USA)). 1987. Contract AC04-76DP00789. 20p. (CONF-8710117—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012981.

From DNA conference on instrumentation for nuclear weapon effects testing; Arlington, VA, USA (6 Oct 1987).

The sensitivity of x-ray photoelectric detectors (PED's) with conical cathodes to the divergence of an incident x-ray beam has been studied theoretically. Using finite element zoning, a simple model has been constructed for computing the net effective yield with typical source-detector geometries. Parameter studies reveal that strong averaging of the local photoelectron yield occurs when

no apertures are interposed between the source and the cone, rendering the net yield nearly insensitive to any off-axis tilt of the cone up to 10°. However, with apertures the net yield becomes a strong function of cone tilt. Lastly, the net yield requires no more than a 6% correction when realistic calibration and fielding geometries are compared. 14 figs.

46118 **(SAND—87-1271C) Thin-foil x-ray dosimeters with millisecond response time dose and heat-flow calculations.** Fehl, D.L.; McMurtry, W.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 22p. (CONF-8710117—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012977.

From DNA conference on instrumentation for nuclear weapon effects testing; Arlington, VA, USA (6 Oct 1987).

The qualification of many electronic and structural components often requires radiation tests under realistic pulsed conditions, and such tests may include vulnerability to x rays. A family of thin-foil thermal dosimeters with ≦1 ms response time has been developed to obtain an absorbed x-ray dose in representative materials for both well- and poorly-collimated geometries. This paper describes present understanding of such gauges. The subject is introduced by commenting on dose measurements in general and the current status of thermal dosimeters in particular. Then the gauges are described simply and their temporal response to a pulsed x-ray input is shown. The deposition of x-rays and subsequent losses are also presented.

46119 **(SLAC-PUB—4285) The Mark II vertex detectors: Status and prospects.** Jaros, J.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 16p. (CONF-8609283—2). NTIS, PC A02; 6. File Number DE87011590.

From Workshop on vertex detectors: state of the art and perspectives; Erice, Italy (21 Sep 1986).

The art of detecting the decay vertices from heavy quarks and leptons is comparatively new at electron-positron storage rings. So far, drift chambers positioned just outside the vacuum pipes which surround the interfaction region have provided the first accurate determinations of the tau and bottom lifetimes, and confirmed earlier measurements of charmed particle lifetimes. "Second generation" vertex detectors have demonstrated the feasibility of tagging heavy flavors by observing decay vertices, and are being used to search for anomalous decay topologies. These chambers have modest resolution on the scale of the effects they seek to measure, but are now well-understood and reliable tools. A generation of vertex detectors, considerably more ambitious, is under construction for experiments at SLC and LEP. They boast impact parameter resolution improved by a factor of four or more over previous detectors, and sub-millimeter track-pair resolution. The Mark II collaboration hopes to reach these goals with a high pressure precision drift chamber, and eventually surpass them with the addition of a silicon microstrip detector.

46120 **(UCID—20334-Rev.1) LIGHT: A ray tracing code to simulate light collection in scintillation spectrometers and light pipes.** Slaughter, D. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014611.

LIGHT is a Monte Carlo code which simulates reflection and transmission of scintillation light by ray tracing. The light source is a short line whose origin and orientation may be fixed or uniformly distributed over a cell. Up to ten axially symmetric cells with wavelength dependent indices of refraction, attenuation, and reflection may be constructed from truncated cones sharing a common axis. Surface reflectivity may be specular or diffuse and reflective properties may be distinct on each surface within each cell. Wavelength may be changed upon reflection in order to simulate walls covered with a phosphor, but polarization effects are not included. The code, which has versions running on the CDC 7600, CRAY and IBM/PC or compatible computers, provides graphics displays of the spatial and wavelength distribution of light reaching either end of the geometry as well as the distribution function of light amplitudes collected from a large number of sources so that spectrometer pulse height distributions are simulated.

46121 **Sensitive gas-phase photoacoustic spectrometer with provision for simultaneous recording of absorption spectrum.** Chakrapani, G.; Venkateswarlu, P.; Rao, Y.V.; George, M.C. (Department of Physics, Alabama A&M University, Normal, Alabama 35762). *Review of Scientific Instruments;* **58**: No. 10, 1871-1878(Oct 1987).

The design of a sensitive pulsed photoacoustic spectrometer system for studying media in gaseous phase in the visible and ultraviolet regions is described. The system provides for simultaneous recording of the laser absorption spectrum of the sample by measuring the radiation transmitted through the sample cell. A highly sensitive optogalvanic detection subassembly for recording the calibration spectrum and analog signal processing/averaging electronics including gated integrators also form part of the system. Typical sensitivities of detection are a few tens of picobar acoustic pressure disturbances induced through two-photon absorption in iodine vapor in the sample cell and 0.1 pC charge fluctuation induced in the neon/uranium hollow cathode discharge through optogalvanic effect. Typical recordings of the photoacoustic, laser absorption, and two-photon photoacoustic spectra of the saturated vapor of iodine at room temperature in the presence of air at atmospheric pressure are presented together with the optogalvanic calibration spectra.

46122 **Ion-induced X-ray studies with a high luminosity von Hamos crystal spectrometer.** Vane, C.R.; Raman, S.; Smith, M.; Heard, J.; Walkiewicz, T. (Oak Ridge National Lab., TN; Yale Univ., New Haven, CT; Edinboro Univ., PA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 59-63(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A high-resolution, high-efficiency, von Hamos geometry, Bragg crystal X-ray spectrometer has been developed and mounted on a beamline at the Holifield Heavy Ion Research Facility at the Oak Ridge National Laboratory. Measurements have been made of K and L X-rays emitted from a variety of targets and projectiles. Instrument performance characteristics are reported here along with spectra from fast projectile ions and very low intensity target emission - areas of measurement for which this spectrometer is especially suitable.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 45814

46123 **(SAND—87-1615C) Variations in semiconductor device response in a medium-energy x-ray dose-enhancing environment.** Beutler, D.E.; Fleetwood, D.M.; Beezhold, W.; Knott, D.; Lorence, L.J. Jr.; Draper, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 27p. (CONF-870724—17). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012400.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

A series of experiments was performed to investigate the response of semiconductor devices to medium-energy x-ray irradiation under conditions in which dose-enhancement effects are very important. The response of MOS capacitors to "dose-enhanced" radiation can depend on incident radiation spectra, temperature of the device, and oxide electric field. Indeed, the amount of enhanced response can vary by as much as a factor of 10 as these conditions are changed. In such cases, it appears that changes in electron-hole recombination and hole trapping as a function of radiation energy are very important to the interpretation of the results. Therefore, coupled electron/photon transport codes such as the Monte Carlo integrated TIGER series (ITS), which consider only changes in the dose deposited in the device active region, are inadequate, at least in some cases, for predictions of dose-enhancement effects in semiconductor devices. In addition, the response of semiconductor diodes to dose-enhanced radiation appears to be qualitatively different from that of capacitors, and differs markedly in value from code predictions. Hence, an understanding of the modification of

incident radiation by its interactions with dose-enhancing materials alone is insufficient to predict the response of semiconductor devices. The dependence of the device response on radiation spectra, electron-hole recombination, and hole transport and trapping, must also be included to assure good simulation fidelity of tests for devices to be used in dose-enhancing environments.

46124 **(UCRL—95307) Gallium arsenide integrated optical devices for high-speed diagnostic systems.** McWright, G.; Lowry, M.; Takeuchi, E.; Murphy, G.; Tindall, W.; Koo, J.; Roeske, F. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 8p. (CONF-8703127—2). NTIS, PC A02. File Number DE87013107.

From 4. international technical symposium on optical and electro-optical applied science and engineering; Hague, Netherlands (30 Mar 1987).

The design, fabrication, and evaluation of waveguide electro-optic modulators in gallium arsenide for application to high-speed diagnostic systems are discussed specifically. This paper is focused on high bandwidth, single event analog modulation, and radiation susceptibility of these devices.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 45149, 45698, 45716, 45812, 45869, 45964, 45968, 46097, 46418

46125 **(BNL—39910) Metal-sensing layer-semiconductor and metal-sensing layer-metal heterostructure gas sensors.** O'Leary, M.; Li, Zheng; Fonash, S.J. (Pennsylvania State Univ., University Park (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-871027—29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011293.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Extremely sensitive gas sensors can be fabricated using heterostructures of the form metal-sensing layer-semiconductor or metal-sensing layer-metal. These structures are heterostructure diodes which have the barrier controlling transport at least partially located in the sensing layer. In the presence of the gas species to be detected, the electrical properties of the sensing layer evolve, resulting in a modification of the barrier to electric current transport and, hence, resulting in detection due to changes in the current-voltage characteristics of the device. This type of sensor structure is demonstrated using the Pd/Ti-O/sub x/Ti heterostructure hydrogen detector.

46126 **(DP-MS—87-41) Controlled, economical and reliable volume measurement system for the laboratory.** Clark, J.P.; Maxwell, S.L. III. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jul 1987. Contract AC09-76SR00001. 7p. (CONF-870713—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012390.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Volume measurements are the most common measurements in the analytical laboratory and hence often receive minimal attention. At the Savannah River Plant (SRP), major changes in pipeting techniques and equipment were made that have reduced equipment costs by over $1,000,000 since 1982 and have cut pipeting and radiation exposure time by at least 50%. Extensive statistical studies were made to assure that the quality of volumetric measurements was not compromised by the changes. The paper discusses: the former program which used glass micropipets for accountability measurements and air displacement pipetors (ADP) with disposable tips for routine measurements; the experiments which revealed half the error associated with ADPs was due to equipment and half to operators; studies which provided information to reduce both types of error; a training program for pipet operators and a calibration program for adjustable ADPs; and the volumetric measurements control program which uses automated equipment and software to facilitate periodic calibration checks and/or recalibration of over 250 adjustable ADPs being used in one SRP laboratory.

46127 (INIS-mf—10946, pp 1-8) **Ambient fallout sampler adapted for the Negev desert.** Rotem, H.; Ronen, A.; Pollak, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46128 **(LA-UR—87-1615) Advancing instrumentation and control at the Nevada Test Site: An incremental approach toward a global solution.** Trujillo, L.T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-871028—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010117.

From Instrument Society of America international conference and exhibit; Anaheim, CA, USA (5 Oct 1987).

The increased overall complexity and cost of modern experiments involving underground nuclear weapons testing at the Nevada Test Site (NTS) demands that we use modern computer control systems rather than "well-established" traditional technology. Historically, instrumentation and control have employed large numbers of expensive, heavy hardwire cables extending from surface ground zero, to a diagnostics area underground in a vertical shaft. The cables are then terminated and in most cases perform singular functions. By adapting industrial instrumentation and control techniques (namely programmable computer control and distributed input/output) we can be connected to a large number of data and power distribution channels with a single pair of fiber optic or coaxial cables. However, to gain system confidence and to modify transferred technology to our unique needs, we integrate such technology incrementally. This paper will discuss examples of our incremental approach by describing some weapon event tests. This paper will also discuss goals for future automation at the NTS.

46129 **(LBL—22993) Theory and applications of maps on SO(3) in nuclear magnetic resonance.** Cho, H.M. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 304p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87014688.

Theoretical approaches and experimental work in the design of multiple pulse sequences in Nuclear Magnetic Resonance (NMR) are the subjects of this dissertation. Sequences of discrete pulses which reproduce the nominal effect of single pulses, but over substantially broader, narrower, or more selective ranges of transition frequencies, radiofrequency field amplitudes, and spin-spin couplings than the single pulses they replace, are developed and demonstrated. 107 refs., 86 figs., 6 tabs.

46130 **(LBL—23616) Semiconductor detector performance for low-energy x-rays.** Jaklevic, J.M.; Walton, J.T.; McMurray, R.E. Jr.; Madden, N.W.; Goulding, F.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 15p. (CONF-870610—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014132.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

Factors that limit the capabilities of semiconductor detectors at photon energies below 5 keV include energy resolution, detector efficiency, and detector-related continuum background. These properties can be controlled to a certain extent by optimal detector design and fabrication techniques. We describe measurements on the low-energy response of Si(Li) detectors obtained using a tunable, low-energy monochromatic source. Window thicknesses have been measured for a number of devices using different materials for the entry contact. The interpretation of these results in terms of existing detector window models is discussed. Results obtained using a new contact structure demonstrate that a dramatic reduction in window-related absorption in Si(Li) detectors can be achieved.

46131 **(SAND—86-8055) Instrumentation system for testing gas transfer systems.** Porter, J.D. (Sandia National Labs., Livermore, CA (USA)). Aug 1987. Contract AC04-76DR00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014269.

An instrumentation system was designed and built to support testing of gas transfer systems. It can handle up to 60 channels (total) of pressure, strain, displacement, and thermocouple data. This report gives operating instructions and design details for the signal conditioning and monitoring sections and describes the interface to the data recording computer.

46132 **(SAND—87-0382C) Pyroelectric line scanner for remote IR imaging of vehicles.** Jakowatz, C.V. Jr.; Smiel, A.J.; Eichel, P.H. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-8708110—6). NTIS, PC A02. File Number DE87012127.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

The design and development of a small-aperture imaging system used for surveillance of vehicular traffic at night is discussed. Such a sensor may have applicability to the safeguarding of a secure facility, where it is important to monitor vehicle activity near the facility perimeter. The sensing element is a linear pyroelectric focal plane array. Motion of a target vehicle provides for scanning in the horizontal direction, and negates the need for a chopper to produce a differential IR signal. Also presented are various digital image processing procedures that are employed to enhance the collected image data, since the images produced by such an array are qualitatively quite different than those obtained in the visible portion of the spectrum. The array consists of 32 lithium tantalate ($LiTaO_3$) elements spaced on 15 mil centers on a single crystal, with element dimensions of 13 by 32 mils. Thirty-two individual on-chip hybrid detector pre-amplifiers reduce the large switching noise that would accompany post-multiplexer amplification. Processed images collected with this prototype system are shown. 4 refs., 7 figs.

46133 **(UCRL—97094) Programmable 10 MHz optical fiducial system for hydrodiagnostic cameras.** Huen, T. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 10p. (CONF-8708110—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013223.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A solid state light control system was designed and fabricated for use with hydrodiagnostic streak cameras of the electro-optic type. With its use, the film containing the streak images will have on it two time scales simultaneously exposed with the signal. This allows timing and cross timing. The latter is achieved with exposure modulation marking onto the time tick marks. The purpose of using two time scales will be discussed. The design is based on a microcomputer, resulting in a compact and easy to use instrument. The light source is a small red light emitting diode. Time marking can be programmed in steps of 0.1 microseconds, with a range of 255 steps. The time accuracy is based on a precision 100 MHz quartz crystal, giving a divided down 10 MHz system frequency. The light is guided by two small 100 micron diameter optical fibers, which facilitates light coupling onto the input slit of an electro-optic streak camera. Three distinct groups of exposure modulation of the time tick marks can be independently set anywhere onto the streak duration. This system has been successfully used in Fabry-Perot laser velocimeters for over four years in our Laboratory. The microcomputer control section is also being used in providing optical fids to mechanical rotor cameras.

46134 **Pulse shapes of nanosecond photoacoustic signals in liquids detected by piezoelectric foil.** Komorowski, S.J.; Eyring, E.M. (Department of Chemistry, University of Utah, Salt Lake City, Utah 84112). *Journal of Applied Physics;* **62**: No. 7, 3066-3069(1 Oct 1987).

A nonringing detection system based on 28-μm-thick piezoelectric, poly(vinylidene difluoride) foil has been constructed for studying photoacoustic signals in liquids. Excellent agreement between theoretical and experimental photoacoustic pulse shapes has been observed. This system is well suited for monitoring radiationless relaxation processes in solutions on a nanosecond time scale.

46135 **Development of a high-sensitivity, computer-controlled titration calorimeter.** Baisden, P.A.; Grant, P.M.; Kinard, W.F. (Nuclear Chemistry Division, L-234, Lawrence Livermore National Laboratory, Livermore, California 94550). *Review of Scientific Instruments;* **58**: No. 10, 1937-1941(Oct 1987). Contract W-7405-ENG-48.

A highly sensitive, adiabatic titration calorimeter controlled by a personal computer is described. Operation of the entire calorimetric titration is automated, including the thermoelectric offset of the heat of stirring, the electrical calibration of the heat capacity, the addition of titrant, and the measurement of the heat of reaction. The average uncertainty in heat measurements was ≅ +- 0.003 J for titrant additions generating 0.025 to 1.0 J of heat change in a 50-ml sample. Calibration of the calorimeter using tris-(hydroxymethyl) aminomethane [TRIS] gave excellent agreement with previously published values.

46136 **Two-dimensional spatial imaging based on acoustooptical deflectors.** Yappert, M.C.; Kimbrell, S.M.; Yeung, E.S. (Iowa State University, Ames, Iowa 50011). *Applied Optics;* **26**: No. 17, 3536-3541(1 Sep 1987).

Two acoustooptical deflectors placed orthogonal to each other allow the scanning of a laser beam in two dimensions without mechanical movement. A complete scan is possible in 50 μs, providing a spatial resolution of 20 x 125 spots. This is used to follow the development of plumes generated by laser vaporization from a surface. Both Na atoms and Pb_2 dimers can be monitored by absorption over the lifetime of the plume. The use of a second channel in the transient digitizer allows normalization to correct for variations in laser intensity and deflection efficiencies during the scan. Concentration maps for each can thus be obtained.

46137 **Measurement of the gravitational acceleration of the antiproton: An experimental overview.** Jarmie, N. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 437-441(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An ambitious experiment is being developed to measure the force of the antiproton due to the gravitational field of the earth. The technique consists in obtaining antiprotons of the lowest energy possible form the LEAR facility at CERN, decelerating them further in an external beam line, trapping and cooling them to ultra low energy, and measuring their gravitational acceleration by time-of-flight methods. The experiment has been granted CERN approval (PS-200). Present plans and initial development efforts are described.

46138 **In Situ elastic property sensors.** Olness, D.; Hirschfeld, T.; Kishiyama, K.; Steinhaus, R. (Lawrence Livermore National Lab., CA). pp vp of Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. Washington, DC; American Chemical Society (1987). (CONF-870316—).

From 38. Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy; Atlantic City, NJ, USA (9 Mar 1987).

Elasticity is an important property of many materials. Loss of elasticity can have serious consequences, such as when a gasket deteriorates and permits leakage of an expensive or hazardous material, or when a damping system begins to go awry. Loss of elasticity can also provide information related to an ancillary activity such as degradation of electrical insulation, loss of plasticizer in a plastic, or changes in permeability of a thin film. In fact, the mechanical properties of most organic compounds are altered when the compound degrades. Thus, a sensor for the mechanical properties can be used to monitor associated characteristics as well. A piezoelectric material in contact with an elastomer forms an oscillating system that can provide real-time elasticity monitoring. This combination constitutes a forced harmonic oscillator with damping provided by the elastomer. A ceramic oscillator with a total volume of a few mm^3 was used as an elasticity sensor. It was placed in intimate contact with an elastomer and then monitored remotely with

a simple oscillator circuit and standard frequency counting electronics. Resonant frequency shifts and changes in Q value were observed corresponding to changes in ambient temperature and/or changes in pressure applied to the sample. Elastomer samples pretreated with ozone (to simulate aging) showed changes in Q value and frequency response, even though there were no visible changes in the elastic samples.

46139 **(ORNL/tr—87/13) The analysis of field-ion microscope photographs with atomic resolution.** Drechsler, M.; Wolf, P. (Oak Ridge National Lab., TN (USA); Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin (Germany, F.R.)). 1987. Contract AC05-84OR21400. Translated from proceedings of the fourth international conference on electron microscopy, Berlin, Sep 1958, pp 835-848. (CONF-580903—1; CONF-570902—1). 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012682.

From 4. international conference on electron microscopy; Berlin, F.R. Germany (10 Sep 1958).

The attempt was made to obtain high-resolution field-ion microscope photographs at operating temperatures of 80°K. In the case of very sharp tungsten tips (radius 200 A) it was possible to image first-nearest neighbors (object resolution 2.7 A). For simplifying evaluation of photographs, a scale model of a W-tip was produced. The paper describes how the indexing of more highly indexed faces can be detected and how local and mean radii of curvature of the crystal surface can be measured by analysis of the photographs. Magnifications were determined by measuring known lattice spacings and by measuring plane pole distances, taking into consideration the measured local radii. Within a photograph, systematic magnification fluctuations by a factor of 3 were detected, which lead to characteristic image distortions. Finally the paper describes how the interplanar spacings can be measured by photographic analysis without knowledge of the unit cell.

46140 **Intensity ratio method using laser Doppler velocimetry (LDV) optical system.** Son, J.Y.; Farmer, W.M. (Univ. of Tennessee Space Institute, Tullahoma, TN 37388). pp 114-121 of Proceedings of ICALEO '86. Toledo, OH; Laser Institute of America (1986). (CONF-861197—).

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

The effects of index of refraction, and receiving lens size and location on the intensity ratio of two points in the forward scattering lobe of the laser Doppler velocimeter optical system are analyzed using a generalized Mie solution for scatter from two coherent beams.

46141 **A thermographic look at plasma spraying.** Kelly, M.D.; Abney, L.D. (Monsanto Research Corp., Mound, Miamisburg, OH). pp 31-32 of An international conference on thermal infrared sensing for diagnostics and control (Thermosense VIII). Kaplan, H. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8509181—).

From 8. thermosense conference; Cambridge, MA, USA (16 Sep 1985).

Plasma spray systems are used to deposit high tempaerture materials on substrates to form coatings. Thermal analysis of these systems will assist in determining spray parameters for different materials. Infrared videothermography was used to measure temperature profiles and particle velocities of these plasma spray systems. Thermal gradients were defined, and an equatorial temperature profile was estimated. Changes in particle velocities were determined, and the thermal effect of particles on the plasma particle velocities were determined, and the thermal effect of particles on the plasma during spraying was observed. The thermography system was able to investigate high temperature plasmas above 15,0000°C, study particle movements, and analyze flame profiles.

46142 **Current status of professionalism in commercial infrared sensing.** Courville, G.E. (Oak Ridge National Lab., Oak Ridge, TN). pp 2-6 of An international conference on thermal infrared sensing for diagnostics and control (Thermosense VIII). Kaplan, H. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8509181—).

From 8. thermosense conference; Cambridge, MA, USA (16 Sep 1985).

Recent events of interest to Thermosense VIII attendees are discussed. This includes training programs, conferences, standards, significant articles, and professional group activities.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

46143 **(AD-A—181400/3/XAB) Large blast-wave simulators (lbs) with cold-gas drivers: computational design studies. Final report.** Opalka, K.O. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Mar 1987. 57p. (BRL-TR—2786). NTIS, PC A04/MF A01.

Computational, parametric design studies were carried out using the BRL-QID hydrocode to investigate the effects of variations in length of a US-LBS designed to simulate blast waves within a predefined test envelope. The simulation requirement was based on a 60m/kT 1/3 height-of-burst, scaled, tactical explosion for shock overpressures ranging from 14 to 240 kPa (2-35 psi) and weapon yields rangining form 1 kT to 1 MT. The US-LBS design is based on the LBS at the Centre d'Etudes de Gramat (CEG), France. However, the cross-sectional reference area of the test section is expected to be twice the size of the French facility. Studies were performed to investigate the effects of changes of the driver length, the expansion-tube length without RWE and the expansion tube length with a passive RWE. Results are presented in the form of design envelopes, and discussed. Recommendations are made for the US-LBS design.

46144 **(AD-P—005361/1/XAB) Expanded simulation techniques: DIRECT COURSE - a 1-kt height-of-burst nuclear-blast simulation. MINOR SCALE - an 8-kt surface nuclear-blast simulation.** Flory, R.A. (Washington Research Center, Alexandria, VA (USA)). Aug 1986. 19p. NTIS, PC A02/MF A01.

This article is from Minutes of the Explosives Safety Seminar (22nd) Held in Anaheim, California on 26-28 August 1986. Volume 2, AD-A181 275, 1493-1511.

In October 1983, DIRECT COURSE, the world's largest non-nuclear height-of-burst (HOB) event took place. In June 1985, MINOR SCALE, the world's largest (8kt equivalent) non-nuclear surface event, took place. These two events represented a marked departure from the earlier rather standard and sporadic 1-kt equivalent surface events conducted by the Defense Nuclear Agency (DNA). By developing these two new techniques as viable simulations, DNA has opened the door to further phenomonology research and airblast effects testing on a scale not previously attainable. The 1-kt equivalent HOB technique offered the opportunity to examine on a large scale, the phenomonology associated with the regular reflection, irregular Mach-reflection, and regular Mach reflection regions together with the associated flow fields, both dusty and clean. The greater than 1-kt technique afforded an opportunity to examine structures, weapons systems, etc. at a significantly different impluse level than that previously available. This paper will reviews the two new techniques and assesses their simulation fidelity.

46145 **(AD-P—005362/9/XAB) Damage distant airblast from MINOR SCALE.** Reed, J.W. (Sandia National Labs., Albuquerque, NM (USA). Ground Motion and Seismic Div.). Aug 1986. 13p. NTIS, PC A02/MF A01.

This article is from Minutes of the Explosives Safety Seminar (22nd) Held in Anaheim, California on 26-28 August 1986. Volume 2, AD-A181 275, 1513-1525.

An unexpected change in winds at 4-5 km MSL caused airblast ducting and focusing on Carrizozo, NM, 60 km east from MINOR SCALE. In result, this 4.8-kt ANFO (ammonium nitrate-fuel oil) explosion test, rattled the town with 300 Pa (0.0435 psi) overpressure, according to the microbarograph records. Four large (8 x 10 ft) store windows are broken. Weather data which were collected during this event show that conditions changed near shot

time, as needed to explain this result. It appears that the variability of winds over the mountains region around WSMR is appreciably larger than over flatter terrain, so that airblast propagation predictions are subject to significant error. Microbarographs are essential in surrounding communities, to document the explosion airblast strength when unexpectedly enhanced blasts occur. The provided empirical model for estimating window damage from expected overpressure appeared to work well. As expected, large windows were the first to fail from the blast.

46146 **(AD-P—005368/6/XAB) Blast testing of expedient shelters in model scale.** Esparza, E.D. (Southwest Research Inst., San Antonio, TX (USA)). Aug 1986. 39p. NTIS, PC A03/MF A01.

This article is from Minutes of the Explosives Safety Seminar (22nd) Held in Anaheim, California on 26-28 August 1986. Volume 2, AD-A181 275, 1641-1679.

A research program was conducted to evaluate the blast resistance of expedient fallout shelters designed for the civilian population in the event of a nuclear attack. As part of this research, model-size shelters of six different designs were tested in a shock tunnel at average overpressure levels of 2.8, 4.6, and 8.8 psi. Measurements of the external blast pressures and internal pressure leakage into the model shelters were made. The expedient shelters tested utilize, in general, shallow soil excavation, load-bearing members of timber or doors, and soil-covered roofs. Replica model sizes were selected so that the shock tunnel load durations were long enough to test in the quasi-static load realm. Some of the shelter designs survived at every overpressure level very well, while other tests items suffered structural failures in almost every case. This paper presents a brief description of the experiments, including some details of the shelters, of the model fabrication and pressure measurement system, and a summary of the results.

46147 **(LA—11080-MS) Lofting of dust by very large explosions.** Mason, A.S.; Finnegan, D.L.; Hagan, R.C.; Raymond, R. Jr.; Cocks, G.G.; Zoller, W.H.; Peach, C.L. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012677.

One of the goals of the Minor Scale test was to determine the quantity, form, and composition of dust lofted by a large detonation of a conventional high explosive at ground level. The explosive charge was 4427 tonnes of ammonium nitrate-fuel oil (ANFO), whose blast effect is approximately equal to that of an 8 kT nuclear device. The experimental techniques used to determine the amount of dust were (1) use of elements in soil as natural tracers, (2) inclusion of tracer elements in the ANFO charge and the immediate surroundings, (3) airborne collection of the lofted dust on filter media, and (4) analysis of the samples for both tracers and dust. The tracer content of the sample can then relate the dust collected to the total amount lofted and to the location of its origin within the experimental setup. Indium, in the oxide form, was placed within the explosive charge, and tantalum as very fine dust, was placed near the soil surface immediately adjacent to the charge container. The amounts of the tracers and of dust collected by each filter were measured by instrumental neutron activation analysis. A research aircraft equipped with well-characterized high-volume filter samplers was flown through the dust cloud at 10 levels between the top at 4.6 km and the bottom at 1.7 km above ground level. The cloud dust density was distinctly biomodal; its maxima were at 4.1 and 2.9 km. The majority of the indium was associated with the dust in the upper part of the cloud, and the majority of the tantalum was in the lower part. The estimate of the total dust lofted by use of the naturally occurring tracers was 3.0×10^9 g. Samples are being studied by scanning electron microscopy to determine their particle size and composition distributions as functions of location within the cloud.

46148 **(LA-UR—87-322) A study of diverging detonation in high-explosive systems.** Tang, P.K. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 6p. (CONF-871040—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006070.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

Initiation of an insensitive high-explosive main charge can be achieved by using a booster. The requirement for the booster high explosive should be high sensitivity rather than high energy. Using a reactive model, this study presents the evolution of detonation in PBX-9502 main charge with two different booster materials: low-density ultrafine TATB and X-0407 in a diverging configuration. 7 refs., 3 figs.

46149 **(SAND—87-0618C) Pyrotechnic component development at Sandia National Laboratory.** Wilcox, P.D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871040—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006899.

From International symposium on pyrotechnics and explosives; Beijing, China (12 Oct 1987).

Pyrotechnic and explosive devices are designed at Sandia National Laboratories, SNL, which must satisfy high reliability requirements for reliable function and storage life. Since only a small number of devices may be built, high standards of quality of both the explosive and structural materials are necessary. We have developed special alloys and glass-ceramic seals for headers and structural parts of these devices to satisfy requirements for minimum size and weight but with increased ruggedness and safety. Hermetic sealing is used extensively to aid in the control of corrosion and aging effects. There is an increasing demand for the integration of these devices with safer (less sensitive) materials, better handling methods, and the use of electrical or fiber optic logic input elements. This paper addresses the trends in active materials, structural materials and a new method of ignition which enhances device designs compatible with low voltage and digital electronics.

46150 **(SAND—87-0927C) Spectroscopic studies of shocked and detonating explosives.** Renlund, A.M.; Trott, W.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870753—70). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014216.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Real-time observation techniques including single-pulse Raman scattering, time-resolved infrared spectral photography, emission spectroscopy and fast-framing photography have been used to study chemical and physical changes in shock-loaded and detonating explosive materials. Experiments have focused on how material variables such as density and particle size may affect emission characteristics in detonating high explosives (HEs). We have also studied effects of pressure and temperature on vibrational frequencies in shocked HEs. 14 refs., 4 figs.

46151 **(SAND—87-1244C) Visible emission from granular explosives during shock initiation.** Setchell, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870753—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012361.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The current work illustrates how visible emission from an explosive/window interface can be used to qualitatively examine chemical energy release during shock wave growth towards detonation. The integrated intensity measurements show temporal and spatial properties of the energy release. The emission spectra show definite features, although identification of emitting species is difficult.

46152 **(SAND—87-1273C) Jet formation and characterization of a conical shaped charge.** Stofleth, J.H.; Owenby, R.N. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-8708110—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012102.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A Conical Shaped Charged (CSC) is an explosive assembly used as a single point penetrator in applications ranging from commercial to national defense. The formation, flight characteristics, and penetration effects of the CSC are of great importance to its users. Because of the extreme velocities of the shaped charge jet, high speed documentation was necessary to research CSC effects. By use of closure switches and initial velocity studies, framing and lighting information for the Cordin 114 Ultra High Speed camera was determined. After the initial data were gathered, it was determined that another source of documentation was necessary. A Hewlett Packard 150 kilovolt flash x-ray system was implemented, enabling more accurate velocity measurements and a better understanding of jet formation and the CSC during flight. Both techniques of documentation were invaluable in the characterization and research of the conical shaped charge.

46153 **(UCRL—96497) The equation of state of PETN detonation products.** Green, L.G.; Lee, E.L.; Breithaupt, D.; Walton, J. (Lawrence Livermore National Lab., CA (USA)). 28 Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—67). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013796.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

We have made shock Hugoniot and expansion measurements on the detonation products of PETN over the range .5 to 114 GPa. We find that for PETN which is relatively oxygen rich as opposed to most other explosives CJ measurements, expansion measurements and supra-compression measurements are consistent with a time independent EOS. In this paper we have compared these results with various equation of state descriptions. The results are The Equation of State of PETN Detonation Products. 10 refs., 5 figs., 2 tabs.

46154 **Thermographic observation of hydrocarbon oxygen explosions.** Abney, L.D.; Kelly, M.D.; Mohler, J.H. (Monsanto Research Corp., Mound, Miamisburg, OH). pp 33-35 of An international conference on thermal infrared sensing for diagnostics and control (Thermosense VIII). Kaplan, H. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8509181—).

From 8. thermosense conference; Cambridge, MA, USA (16 Sep 1985).

Balloons containing methane-oxygen mixtures were detonated to simulate ordinance fireballs. To establish fireball characteristics, analyses were required of reacting temperatures, thermal profiles, and mixing patterns of the methane-oxygen products with the atmosphere. Infrared videothermography measured and recorded the detonation and gas cloud mixing. Image digitization and in-band energy calculations were done to compare reaction parameters for different balloon tests.

4502 Nuclear

REFER ALSO TO CITATION(S) 46128

46155 **(AD-A—181506/7/XAB) Analysis of radiation exposure for personnel on the residence islands of Enewetak Atoll after Operation Greenhouse, 1951-1952. Technical report, 3 December 85-20 April 1987.** Thomas, C.; Goetz, J.; Klemm, J. (Science Applications International Corp., McLean, VA (USA)). 20 Apr 1987. 31p. (SAIC—85/1935). NTIS, PC A03/MF A01.

The radiological environments and reconstructed for the residence islands of Enewetak Atoll following the roll-up phase of Operation GREENHOUSE in May 1951. The residence islands received fallout during Operation GREEHOUSE (April/May 1951) as a result of Shots, DOG, EASY, and ITEM. From the reconstructed radiological environments and assumed personnel activity scenarios, equivalent personnel film badge doses are calculated, by month, from June 1951 to June 1952. For a individual assigned to Enewetak Atoll during this period, a mean dose of 1.5-2.0 rem would have been accrued, depending on the residence island to which he was assigned.

46156 **(AD-A—181530/7/XAB) Terrorism - a global perspective. Student essay.** Gwin, S.R. (Army War Coll., Carlisle Barracks, PA (USA)). 21 Mar 1987. 41p. NTIS, PC A03/MF A01.

The trends in international terrorism point toward an escalation through the remainder of this decade and into the 1990's. Increases will be reflected in both the number and the lethality of attacks, mostly as a result of the availability and use of sophisticated technology by terrorist groups. The exporting of terrorism has been a major factor in Europe the last few years and is probably a foreboding of what the US can anticipate. The trend toward the use of high technology and a confluence of other factors indicate an increased probability of eventual nuclear terrorism. In combating terrorism, the world community will realize success only through a well-coordinated global program. Such a program will require a universally acceptable definition of terrorism; one which clearly distinguishes between terrorism and illegal forms of warfare. A close study of profiles on terrorist leaders such as the infamous Carlos, provides a clear distinction between terrorists and freedom fighters. In addition to the coordinated global effort, a sustained victory in the war against terrorism will require an adjustment of international political structures to establish a planetization; perspective by all the states of the world community.

46157 **(MHSMP—87-27) Development of a technique for field packaging of damaged nuclear weapons.** Flowers, G.L.; Montague, J.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Aug 1987. Contract AC04-76DP00487. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014326.

A technique was developed for field packaging of damaged nuclear weapons for subsequent transportation to a Department of Energy facility. This procedure would be used at the accident site after the weapon has been inspected, after any fractured high explosive has been removed or stabilized by gelling, and any radioactive debris contained by packaging. The technique uses a rigid foam-in-place polyurethane foam carried in by the Accident Response Group along with shipping containers procured or fabricated at the accident site.

4503 Explosion Detection

46158 **(AD-A—181567/9/XAB) Capabilities of seismic networks and their design. Technical report for the period 1 January-31 March 1987.** Baumstark, R.; Bulin, G.; Campanella, A.; Dysart, P.; Israelsson, H. (Science Applications International Corp., Arlington, VA (USA). Center for Seismic Studies). Apr 1987. 85p. (SAIC—87/1062). NTIS, PC A05/MF A01.

Results of the assessment of capabilities of seismic networks and the design of networks show that a network's location accuracy approaches a near-maximum when stations are distributed over an azimuthal sector of about 180° and that good depth determination requires stations within about 15° of the focus of the event. The latter suggests that global networks should include 100 or more seismological stations if accurate depth estimation is important. A study of about 100 local and regional events detected by NORESS is a systematic effort to test analytical methods being developed for extracting features from seismic waveforms that can be used to identify regional phases, and for recognizing repeated events from a single source such as quarry blasts. The methods under evaluation includes the extraction of frequency-domain spectral parameters, and particle motion information. Substantial effort was devoted to developing concepts and preparing for experiments in international exchange of of seismic waveform data. This work included developing the technical concepts for a potential global seismic-monitoring system. The Center has been heavily involved in an examination of its data-base management system and the development of extensions to handle new types of data - principally data from seismic arrays and data anticipated from forthcoming GSE experiments.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 45825, 46395

46159 (BNL-NCS—39949) The atomic weight and isotopic composition of nitrogen and their variation in nature. Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-8708105—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012867.

From 34. IUPAC General Assembly; Boston, MA, USA (21 Aug 1987).

Two stable isotopes of nitrogen exist in nature, ^{14}N and ^{15}N. The less abundant isotope, ^{15}N, was discovered in 1929 by Naude, who studied the band spectra of nitric oxide, NO. However, the main source of a standard for this element is the air in the atmosphere, which is made up of approximately 78% N_2. Reviewed in this paper is the measurements of the isotopic composition in air and its variation around the world. Also investigated is the variation of the isotopic composition in the various compounds or sources of nitrogen compared to the value in air. Data on the atomic weight and non-terrestrial data for nitrogen is also reviewed.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 44884, 44885, 44886, 44887, 44888, 44907, 44909, 44915, 45006, 45073, 45207, 45319, 45320, 45322, 45323, 45683, 45684, 45887, 45889, 45891, 45981, 46046, 46147, 46219, 46220, 46221, 46222, 46223, 46307, 46311, 46321

46160 (AD-A—181624/8/XAB) Morton arboretum bioassays: earthworm bioassay procedures to evaluate the extent of aerially dispersed lead and cadmium in an urban arboretum. Wilhelm, G.S.; Simmers, J.W.; Marquenie, J.M.; Kelsey, P.D. (Nijverheidsorganisatie TNO, Delft (Netherlands). Hoofdgroep Maatschappelijke Technologie). 27 Jan 1987. 8p. (TNO/P—87/007). NTIS, PC A02/MF A01.

Aerially dispersed heavy metals from a high-speed motorway have been shown to be entering an urban arboretum. Lead (Pb) and cadmium (Cd) were found as remote as 930 m from an east-west, multi-lane motorway. Both Pb and Cd were bioavailable to earthworms (Eisenia foetida) and both metals were more concentrated in surface soils than at depths of 1 meter. Seven sampling stations were established at progressive intervals along the 930 m transect. At all sampling stations, soil cores 15 cm deep and replicated four times were collected. The sod was removed from each sample except for one station 33 m away from the motorway. This was retained and tested along with some additional 1 m depth soil cores. All samples were transported to the U.S. Army Engineer Waterways Experiment Station (WES) where bioassay tests utilizing the earthworm (Eisenia foetida) were conducted under controlled conditions.

46161 (BNL—52088) 1986 environmental monitoring report. Miltenberger, R.P.; Royce, B.A.; Naidu, J.R. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87014449.

The environmental levels of radioactivity and other pollutants found in the vicinity of BNL during 1986 are summarized in this report. The environmental data include external radiation levels; radioactive air particulates and halogens; tritium concentrations; the amounts and concentrations of radioactivity in and the water quality of the stream into which liquid effluents are released; the organics, radioactivity, and water quality of the potable supply wells; the concentrations of radioactivity in biota from the stream; and the concentrations of organics, radioactivity, and the water quality of ground waters underlying the Laboratory. In 1986, the results of the surveillance program demonstrated that the Laboratory has operated within the applicable environmental standards.

46162 (CONF-870444—3) Modeling the relationship between sources and receptors of wet deposition of S and NO/sub x/-N in the intermountain west of the United States. Shannon, J.D.; Lesht, B.M. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011522.

From 16. international technical meeting on air pollution modelling and its application; Lindau, F.R. Germany (6 Apr 1987).

Simulations of the wet deposition of S in the Intermountain West with the ASTRAP model, a linear model of long-term, long-range transport and deposition, show reasonable agreement with limited available observations, and thus lend general support for the view of Oppenheimer et al. that concentrations of sulfate in precipitation were linearly and causally related to SO/sub x/ emissions in the region, largely from smelters, during the period 1980-1983. However, emissions from the major smelters in the region are estimated to contribute only about 30 to 50% of the S wet deposition at the Colorado monitoring sites, even during peak emissions, and thus much of the strong correlation between smelter emission and sulfate concentrations in precipitation appears to have been caused by other factors. Emissions variations and climatological variations are estimated to have had approximately equal influence on the trend of wet S deposition during the period, and to have acted synergistically to produce the marked positive deposition anomaly in Colorado in 1981. The apparent variation in wet deposition, particularly the peak in 1981, cannot be fully accounted for with the model; it is unclear as to whether this is due to small-scale variations unresolvable by ASTRAP, to flaws in the highly parameterized nature of the model, particularly its assumption of linearity, or the noise in the precipitation chemistry data. Model performance in simulating wet deposition of NO/sub x/-N is roughly equivalent to that for wet deposition of S. The seasonal patterns to wet deposition are accurately simulated for both pollutants.

46163 (DOE/ER—0316) Master index for the carbon dioxide research state-of-the-art report series. Farrell, M.P. (ed.). (Oak Ridge National Lab., TN (USA)). Mar 1987. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87012757.

Four State of the Art (SOA) reports, "Atmospheric Carbon Dioxide and the Global Carbon Cycle," "Direct Effects of Increasing Carbon Dioxide on Vegetation," "Detecting the Climatic Effects of Increasing Carbon Dioxide," and "Projecting the Climatic Effects of Increasing Carbon Dioxide," and two companion reports, "Characterization of Information Requirements for Studies of CO_2 Effects: Water Resources, Agriculture, Fisheries, Forests and Human Health" and "Glaciers, Ice Sheets, and Sea Level: Effect of a CO_2-Induced Climatic Change," were published by the US Department of Energy's Carbon Dioxide Research Division. Considerable information on atmospheric carbon dioxide and its possible effects on world climate is summarized in these six volumes. Each volume has its own index, but to make the information that is distributed throughout the six volumes more accessible and usable, comprehensive citation and subject indexes have been compiled. The subject indexes of the individual volumes have been edited to provide a uniformity from volume to volume and also to draw distinctions not needed in the separate volumes' indexes. Also, the comprehensive subject index has been formatted in a matrix arrangement to graphically show the distribution of subject treatment from volume to volume. Other aids include cross references between the scientific and common names of the animals and plants referred to, a glossary of special terms used, tables of data and conversion factors related to the data, and explanations of the acronyms and initialisms used in the texts of the six volumes. The executive summaries of the six volumes are collected and reproduced to allow the readers interested in the contents of one volume to rapidly gain information on the contents of the other volumes.

46164 (ECE—EB.AIR/SEM.1/3) Report of the seminar on the control of sulfur and nitrogen oxides from stationary sources. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 25p. (CONF-8605284—Summ.). Government of the United Kingdom.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

This report summarizes the conclusions of the seminar under the following headings: general conclusions; strategies for reducing sulphur and nitrogen oxides emissions in relation to energy production structure and energy use; fuel treatment; low-emission combustion processes; flue-gas desulphurization and denitrification, and control of SO_2 and NO/sub x/ emissions from industrial processes; by-product utilization and waste disposal; methods and instruments for monitoring sulphur and nitrogen emissions from stationary sources; and methods for the elaboration and setting of standards for sulphur and nitrogen emissions into the atmosphere. Recommendations to the executive body, draft recommendations to the parties to the convention on long-range transboundary air pollution, and a list of introductory reports and discussion papers are also given.

46165 **(GSF-BPT—10/86) Determination of organic substances in precipitations.** Hoefken, K.D.; Bauer, H. (eds.). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften). 1986. 51p. (In German). (CONF-8602145—). NTIS (US Sales Only), PC A04/MF A01. File Number DE87770272.

From Discussion meeting on determination of organic substances in precipitations; Neuherberg, F.R. Germany (26 Feb 1986).

Precipitations remove numerous trace materials from the atmosphere which are absorbed by the soil. While the air is cleaned by that process, enrichment processes and, possibly, harmful effects occur in the biosphere and in materials. Therefore accurate knowledge of the processes which take place during deposition is needed - to quantify not only the self-cleaning of the atmosphere, but moreover the amounts of gases and aerosol particles which reach the earth's surface, so as to be able to assess its pollution load. Two discussion papers are supposed to highlight the current state of knowledge.

46166 **(LBL—23078) Exposure to methylene chloride from controlled use of a paint remover in residences.** Hodgson, A.T.; Girman, J.R. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 40p. (CONF-870695—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014020.

From 80. annual meeting of the Air Pollution Control Association; New York, NY, USA (1 Jun 1987).

A recent laboratory investigation characterized personal exposures to methylene chloride (CH_2Cl_2) for simulated typical uses of paint removers and aerosol finishes containing CH_2Cl_2 in a room-size environmental chamber at two ventilation rates. Because paint removers produced relatively large exposures to CH_2Cl_2 in these experiments, the present investigation was undertaken to measure exposures to CH_2Cl_2 for standardized use of a paint remover in a variety of residential environments. A total of 21 experiments were conducted outdoors and indoors in a garage, a basement workshop, and large and small rooms of a house. In the indoor work areas, ventilation patterns and rates were varied by opening windows and doors and by the use of a household fan. Finishes were removed from uniformly-prepared panels and from chairs. The personal exposure of the worker was determined from the continuous measurement of CH_2Cl_2 concentration in a pumped breathing-zone sample. Personal exposures resulting from the outdoor use of paint remover were very low (6 to 36 ppM.h). Exposures resulting from the use of paint remover indoors without mechanical exhaust ventilation were considerably higher (190 to 2090 ppM-h). In each indoor location, an open window or exterior door (11 to 142 ppM.h). A single-equation mass-balance model was used to produce estimates of theoretical exposures for experiments conducted indoors. The efficacy of the model for predicting exposures was evaluated by comparing theoretical and measured personal exposures. The model performed best for small-volume work areas with low ventilation rates. In general, the model had an accuracy of +-50 percent when applied to experiments conducted in enclosed work areas without an exhaust fan.

46167 **(PB—87-196119/XAB) Characteristics of individual particles at a rural site in the eastern United States.** Mamane, Y.; Dzubay, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 8p. (EPA—600/J-86/353). NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 36, No. 8, 906-911 (Aug 1986).

To determine the nature of aerosol particles in a rural area of the eastern United States, aerosol samples were collected at Deep Creek Lake, Maryland, on various substrates and analyzed by a scanning electron microscope (SEM) and a transmission electron microscope (TEM). SEM analysis of particles larger than 2.5 micrometers collected on Nuclepore filters revealed clay minerals, quartz, gypsum, calcite, spores, pollen, plant debris, fly ash, and sulfates. Particles ranging from 0.3 to 2 micrometers were analyzed by TEM for decomposition rate as well as for reaction with the barium chloride and nitron films.

46168 **(PB—87-197604/XAB) Evaluation test on a hospital-refuse incinerator at Cedars Sinai Medical Center, Los Angeles, California. Final report.** Jenkins, A.; Castronovo, C.; Lindner, G.; Ouchida, P.; Simeroth, D.C. (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Apr 1987. 95p. (ARB/SS—87-11-F). NTIS, PC A05/MF A01.

An evaluation test program was conducted to evaluate the emissions from a hospital refuse incinerator. The refuse incinerator/heat recovery system exhaust gas passed through a fabric filter baghouse before the gas was vented to the atmosphere. The incinerator was operated at an average burn rate of approximately 980 pounds of hospital refuse per hour during the entire test period. The carbon monoxide concentrations were less than 50 parts per million by volume (PPMV) during the entire test period. Analysis for selected trace metals was conducted and emission rates determined. The baghouse removal efficiency for trace metals exceeded 99% and the baghouse removal efficiency for total particulate matter averaged 93% The baghouse did not have a significant effect on the emissions of hydrochloric acid. Mass emission rates for chlorinated organic compounds were determined. Stack gas samples were analyzed for polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs). The data indicate that hospital incinerators are a potential source of PCDD and PCDF emissions to the atmosphere.

46169 **(PB—87-201422/XAB) Application of the urban airshed model to the New York metropolitan area.** Rao, S.T. (New York State Dept. of Environmental Conservation, Albany (USA)). May 1987. 228p. NTIS, PC A11/MF A01.

Ambient ozone concentrations in the New York Metropolitan area, encompassing portions of the States of New Jersey, New York, and Connecticut, often exceeded the ozone National Ambient Air Quality Standard (NAAQS) of 0.12 ppm during the 1980 ozone season. To address this problem a study, entitled Oxidant Modeling for the New York Metropolitan Area Project (OMNYMAP) has been undertaken to provide information on the extent and magnitude of the ozone problem in the New York Metropolitan area during the 1988 ozone season; the impact/benefit achieved with imposition of specific control strategies to which the three states committed themselves in their State Implementation Plans; the role of pollutant transport from the upwind regions into the modeling domain; meaningful and effective control strategies to meet and maintain ozone NAAQS in the New York Metropolitan area.

46170 **(PB—87-203105/XAB) Laboratory analysis of back-corona discharge.** Snyder, T.R.; Vann Bush, P.; Pontius, D.H. (Southern Research Inst., Birmingham, AL (USA)). 1987. 16p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Electrostatics, Vol. 19, 101-114(1987).

The paper discusses an experimental research program to characterize back-corona generation and behavior in a range of environments and geometries common to electrostatic precipitators (ESPs). A wire-parallel plate device was used to monitor the intensity and distribution of back-corona discharges. Back-corona was

generated by subjecting a deposited layer of fly ash to corona current. Back corona emissions were observed with a sensitive video camera. These observations provided new insight into the characteristics of back-corona phenomena. Conditions that were varied during the experiments included ash resistivity, corona-electrode design, corona polarity, and ash-layer thickness and surface condition. The effect of pulsed energization on back-corona was also studied. Analyses of visual observations and measured distributions of corona and back-corona current allowed an assessment of the effects of back corona emissions on ESP operating parameters.

46171 **(PB—87-203279/XAB) Analysis of diffusion field experiments.** Briggs, G.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jun 1987. 65p. (EPA—600/D-87/198). NTIS, PC A04/MF A01.

The report describes general theoretical frameworks for the ordering of diffusion field data in terms of meteorological measurements. The three methods described are surface-layer (Monin-Obukhov) similarity, convective scaling, and statistical theory using wind fluctuations. Early analyses of historic field experiments are reinterpreted in terms of these frameworks and many examples of analyses using these three methods are cited from the literature. The strengths and limitations of each method are discussed at length and the most-effective methods are identified according to stability, height of source, and vertical or lateral diffusion.

46172 **(PB—87-205498/XAB) Health-hazard evaluation report HETA 84-186-1777, Sancap Abrasives, Inc., Alliance, Ohio.** London, M.A.; Ruhe, R.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 23p. (HETA—84-186-1777). NTIS, PC A02/MF A01.

A request was received from the International Chemical Workers Union to investigate respiratory symptoms occurring from possible exposure to silica dust along with neurologic symptoms of memory loss and disorientation from possible exposure to aluminum-oxide dust at the Sancap Abrasives, Inc. facility in Alliance, Ohio. Sancap Abrasives manufactured coated abrasives (sand paper), and had previously discontinued use of abrasives containing silica. No neurotoxic agents were identified at the facility. The authors conclude that silica exposures were not sufficient to pose a serious risk of silicosis. Annual medical examinations were recommended for all workers working in the coated-abrasives division for a total of at least 10 years when silica was used.

46173 **(PB—87-205845/XAB) Industrywide studies report of an in-depth survey at E.I. duPont Denemours and Company, Sabine River Works, Orange, Texas, August 25-28, 1986.** Krishnan, E.R.; Fajen, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 30 Mar 1987. 46p. (IWS—147.32B). NTIS, PC A03/MF A01.

See also PB—86-223203.

In order to assess the extent of worker exposure to 1,3-butadiene, an in-depth industrial hygiene survey was conducted at the E.I. duPont deNemours and Company in Orange, Texas. This facility had a capacity of 490 million pounds per year of adiponitrile (ADN) by synthesis of 1,3-butadiene and hydrogen cyanide. Workers' full-shift exposures to 1,3-butadiene were below the American Conference of Governmental Industrial Hygienists threshold limit value of 10 parts per million (ppm) and the present Occupational Safety and Health Administration Permissible Exposure Limit of 1000ppm. The only exception was a shipping technician's exposure of 28.5ppm. Arithmetic and geometric mean full-shift exposures across all job categories were less than 0.20ppm, except for the shipping technicians whose arithmetic and geometric mean full-shift exposures were 14.6 and 4.69 ppm, respectively. Under normal operating conditions, airborne concentrations in all work environments were at or below 0.60ppm. The authors recommend that consideration be given to converting to a closed loop sampling system for obtaining quality-control readings from barges. A program to convert to 100% magnetic gauges should be undertaken to replace those slip-tube gauges currently in use.

46174 **(PB—87-205852/XAB) Industry-wide studies report of an in-depth survey at Denka Chemical Corporation, Houston, Texas, July 14-17, 1986.** Krishnan, E.R.; Fajen, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 20 Jan 1987. 49p. (IWS—147.27B). NTIS, PC A03/MF A01.

See also PB—86-225406.

Worker exposure to 1,3-butadiene was measured at the Denka Chemical Corporation in Houston, Texas. Neoprene and tetrahydrophthalic anhydride were produced at this facility. Workers full-shift exposures to 1,3-butadiene were below the American Conference of Governmental Industrial Hygienists Threshold Limit Value of 10 parts per million (ppm) and the Occupational Safety and Health Administration Permissible Exposure Limit of 1000 ppm. The arithmetic mean, full-shift exposures for all job categories were less than 1.43 ppm. The authors recommend that the general-dilution ventilation conditions in the quality-control lab be reassessed in order to control exposures to the head shift testers conducting analysis on 1,3-butadiene samples. Replacement of the threaded fittings on the bombs with other fittings should be considered, thus reducing any possible releases of 1,3-butadiene when making closed loop connections to obtain quality-control samples.

46175 **(PB—87-205886/XAB) Health-hazard evaluation report HETA 84-449-1778, Agrico Chemical Company, Pierce, Florida.** Singal, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1987. 14p. (HETA—84-449-1778). NTIS, PC A02/MF A01.

In response to a request from the International Chemical Workers Union an evaluation was made of respiratory problems among workers at the Agrico Chemical Company, Pierce, Florida, which closed in 1979. Specific concern had been expressed regarding exposures to silica, coke, and asbestos. Of 108 persons participating in the study, 91 had worked at the elemental phosphorus facility (EP). Of 88 participants who had ten or more years in the phosphate industry, the 36 workers with ten or more years in the EP facility were no more likely to have chronic cough, shortness of breath, abnormal lung sounds on physical examination, pulmonary function impairment, or x-ray signs of fibrogenic dust exposure than those with less than 10 years exposure. Those working longer than 10 years in the EP facility had numerically higher prevalence of chronic bronchitis and chronic wheeze, but the differences were not statistically significant. The author concludes that no association between health and time at the EP facility could be discerned from the available data, although it is possible that the study participants were not representative of all former facility workers.

46176 **(PB—87-205894/XAB) Health-hazard evaluation report HETA 86-226-1769, Montgomery Hospital, Norristown, Pennsylvania.** Crandall, M.S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1987. 23p. (HETA—86-226-1769). NTIS, PC A02/MF A01.

In response to a request from Montgomery Hospital, Norristown, Pennsylvania, an evaluation was made of possible worker exposures to glutaraldehyde while disinfecting respiratory therapy equipment, bronchoscopes, physical therapy whirlpool tubs, surgical instruments, and anesthesia equipment parts. The author concludes that a health hazard existed from glutaraldehyde during disinfection and sterilizing procedures. The author recommends substitution of less-hazardous materials for glutaraldehyde where possible, construction of a work station with adequate local exhaust ventilation for glutaraldehyde use, installation of a dilution ventilation system in the whirlpool facilities, and use of personal protective clothing when handling glutaraldehyde.

46177 **(PB—87-209037/XAB) Volatile organic hydrocarbon and aldehyde composition in Raleigh, North Carolina during the 1985 woodsmoke study.** Zweidinger, R.; Dropkin, D.; Stump, F.; Tejada, S.; Drago, R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jul 1987. 11p. (EPA—600/D-87/212). NTIS, PC A02/MF A01.

Initial field tests for collection of volatile organic hydrocarbons and aldehydes under EPA's Integrated Air Cancer Project

(IACP) were held in Raleigh, NC during the winter of 1985. Sampling was conducted during 12 hour (7:00-7:00) daytime or nighttime periods. Hydrocarbons were collected by pressurizing 6 liter Summa polished stainless steel cylinders. Aldehydes were collected as 2,4-dinitrophenylhydrazone (DNPH) derivatives using impingers and cartridge collection methods. Sampling locations included the primary outdoor site located in a residential neighborhood, a rural background site and inside and outside three homes operating wood stoves. Non-methane hydrocarbon levels at the primary site ranged from 150 to 850 ppbc while total carbonyls ranged from 3 to 35 ppb (v/v). Benzene levels ranged from 5 to 32 ppbc while formaldehyde levels ranged from 2-14 ppb. Hydrocarbon levels and distributions in the homes were similar inside and outside with a few noted exceptions. Carbonyl levels, however, generally were much higher inside than outside. The elevated carbonyl levels observed inside the homes is likely due to factors other than the presence of a wood stove.

46178 **(PB—87-209540/XAB) Locating and estimating air emissions from sources of polychlorinated biphenyls (PCB).** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). May 1987. 80p. (EPA—450/4-84/007N). NTIS, PC A05/MF A01.

To assist groups interested in inventorying air emissions of various potentially toxic substances, EPA is preparing a series of documents such as this to compile available information on sources and emissions of these substances. The document deals specifically with polychlorinated biphenyls. Its intended audience includes Federal, State, and local air-pollution personnel and others interested in locating potential emitters of polychlorinated biphenyls and in making gross estimates of air emissions therefrom. The document presents information on (1) the types of sources that may emit polychlorinated biphenyls, (2) process variations and release points that may be expected within these sources, and (3) available emissions information indicating the potential for polychlorinated biphenyls release into the air from each operation.

46179 **(SAND—84-0173/2) The Albuquerque winter visibility study: Volume 2, Data appendices.** Einfeld, W.; Homann, P.S. (Sandia National Labs., Albuquerque, NM (USA); Homann (P.S.), Seattle, WA (USA)). Jul 1987. Contract AC04-76DP00789. 193p. NTIS, PC A09. File Number DE87014328.

At the request of the City of Albuquerque, a study was planned and carried out to determine the relative contribution of the various types of air pollution sources to visibility impairment in Albuquerque in winter. The two-month field study (December 28, 1982 to February 23, 1983) involved routine monitoring of pollutant concentrations at two ground sites, routine aerosol monitoring at three ground sites, and limited meteorological measurements and aerosol sampling aloft. This volume contains tabular and graphical listings of all data collected during the course of this study. Data appendices include ground station real-time and aerosol measurements, aerosol and meteorological data from measurements aloft, telephotometer data, soil elemental composition data, background aerosol data, and local meteorological summaries.

46180 **(UCID—21146) Status of the solar and infrared radiation submodels in the LLNL 1-D and 2-D chemical-transport models.** Grant, K.E.; Taylor, K.E.; Ellis, J.S.; Wuebbles, D.J. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014320.

The authors have implemented a series of state of the art radiation transport submodels in previously developed one dimensional and two dimensional chemical transport models of the troposphere and stratosphere. These submodels provide the capability of calculating accurate solar and infrared heating rates. They are a firm basis for further radiation submodel development as well as for studying interactions between radiation and model dynamics under varying conditions of clear sky, clouds, and aerosols. 37 refs., 3 figs.

46181 **(UCRL—15940) Detection of changes in the global troposphere temperature field induced by greenhouse gasses.** Barnett, T.P. (Ocean Research Consultants, La Jolla, CA (USA); Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014245.

Several approaches to detecting the existence of a theoretically predicted CO_2 induced signal in the global temperature field are investigated. It appears that a relatively thin network of observing stations can, when properly analyzed, provide a first order estimate of global temperature change. Using these stations, it is possible to estimate the strength of an a priori CO_2 signal in the 3-dimensional tropospheric temperature field. This signal is derived from two different GCM simulations both with interactive oceans. The observed signal strength over 1960 to 1980 is half that expected theoretically but still demonstrated a trend that is marginally significant. If the discrepancy between observation and theory is due only to the delaying effects of inertial elements of the climate system, then the characteristic delay time is estimated to be roughly 20 years.

46182 **Precipitation fluctuations over Northern Hemisphere land areas since the mid-19th century.** Bradley, R.S.; Diaz, H.F.; Eischeid, J.K.; Jones, P.D.; Kelly, P.M.; Goodess, C.M. (Univ. of Massachusetts, Amherst). *Science (Washington, D.C.);* **237**: 171-175(10 Jul 1987). Contract FG02-85ER60316.

An extensive array of measurements extending back to the mid-19th century was used to investigate large-scale changes in precipitation over Northern Hemisphere land areas. Significant increases in mid-latitude precipitation and concurrent decreases in low-latitude precipitation have occurred over the last 30 to 40 years. Although these large-scale trends are consistent with general circulation model projections of precipitation changes associated with doubled concentrations of atmospheric carbon dioxide, they should be viewed as defining large-scale natural climatic variability. Additional work to refine regional variations and address potential network inhomogeneities is needed. This study attempts to show secular precipitation fluctuation over hemispheric- and continental-scale areas of the Northern Hemisphere.

46183 **Sub-micron particle sampler apparatus.** Gay, D.D.; Mc Millan, W.G. (to Dept. of Energy, Washington, DC). US Patent 4,677,863. 7 Jul 1987. Filed date 25 Mar 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An apparatus is described for sampling sub-micron sized particles contained in a carrier gas sample, comprising: a collection chamber defines a volume and has sample gas inlet and outlet means; means for filtering a sample gas prior to the sample gas entering chamber, the filtering means removing large particles having a diameter of at least about 0.3 microns; means in the collection chamber for removing small particles having a diameter of less than about 0.3 microns. the removing means includes means for cooling gas to a temperature at which moisture in the sample gas is frozen. The small particles are trapped in the frozen moisture; means for removing the small particles from the collection chamber; and means for concentrating and collecting the small particles from the frozen moisture to provide a sample for subsequent analysis.

46184 **(ECE—EB.AIR/SEM.1/R.24) Rational use of energy and change in the pattern of energy consumption in the Federal Republic of Germany - effects on the emission of SO_2 and NO/sub x/.** Beck, P.; Rosolski, P. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 10p. (CONF-8605284—Summ.). Government of the Federal Republic of Germany.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

In the Federal Republic of Germany over 95 per cent of the sulphur dioxide emissions and over 90 per cent of the nitrogen oxides emissions from stationary sources result from the combustion of fossil fuels. The amount of energy used and its partition upon the different energy sources are major factors influencing these emissions, the others being fuel quality and the technologies used for

combustion and flue gas treatment. The paper gives the development of the level and structure of energy consumption in stationary sources from 1966 over 1974 until 1982 and the forecast to 1995. The corresponding development of sulfur dioxide and nitrogen oxides emissions is also given. The paper also outlines legislation for air pollution control passed in the Federal Republic of Germany and its energy programme. 18 refs.

46185 **(ECE—EB.AIR/SEM.1/R.75) Study of alternatives for a 30% reduction of SO_2 emissions in Austria and effects on the economy and consumers.** Kuntscher. (United Nations, Geneva (Switzerland). Economic Commission for Europe). 1986. 11p. (CONF-8605284—Summ.). Government of Austria.

From 4. seminar on the control of sulphur and nitrogen oxides from stationary sources; Graz, Austria (12 May 1986).

In Austria strategies to reduce SO_2 emissions will be necessary since the revision of the Dampfkesselemissionsgesetz (Clean Air Law), the forest law, which is gaining in importance, and the new TA Luft (technical order air) which is planned. This paper outlines the strategies being examined, within the scope of a study by the Ministry of Health and Environment, with a view to the reduction of SO_2 emissions. They take into account Austrian conditions as well as practicality, capital investment, operating costs and reduction effects.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 45153, 45859, 45981, 46161, 46202, 46205, 46206

46186 **(DOE/ID/12584—6) Validation of the prompt alpha-track method.** George, J.L.; Langner, G.H. Jr. (UNC Geotech, Grand Junction, CO (USA)). Aug 1987. Contract AC07-86ID12584. 67p. (UNC/GJ—33(TMC)). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014446.

The Technical Measurements Center has evaluated the reliability of using short-term exposures of alpha-track radon detectors to estimate annual-average radon-daughter concentrations (RDC) in structures in the Grand Junction, Colorado, area. Two sets of data were collected, each consisting of two-, three-, four-, five-, and six-month-long exposures of radon detectors manufactured by Terradex Corporation. Terradex Type SF Track Etch detectors were exposed at 50 stations in 34 structures where previous annual average radon and/or radon-daughter-concentration data were collected. Two detectors were deployed at each station for each short-term exposure. Three additional annual detectors were deployed at each station concurrently with the six-month Fall detectors. The Track Etch detectors were processed at a sensitivity level of 0.2 picocurie . month per liter. All of the short-term Track Etch measurements can reliably estimate the annual average indoor radon concentration in structures in the Grand Junction, Colorado, area. The precision of both the short-term measurements and the prompt alpha-track method of using these measurements is acceptable at 4 picocuries per liter (pCi/l). Glenwood Laboratories began marketing Radtrak radon detectors in February 1986. To conduct a preliminary field evaluation of these devices, two Radtrak detectors were deployed at each station in addition to the Track Etch detectors for the two-month and three-month Spring exposures of this study. Based on this limited data set, short-term Radtrak exposures estimate the annual average radon concentration at 4 pCi/l as reliably as short-term Track Etch exposures. The use of Radtrak detectors deserves further investigation. 8 refs., 18 figs., 10 tabs.

46187 **(HMI-B—434) Programs to calculate human radiation exposure caused by atmospheric diffusion of radioactive substances.** Hagenberg, B.; Hofmann, H.; Wiesner, G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Datenverarbeitung und Elektronik). Feb 1987. 33p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-10862.

This report describes - with a discussion on the mathematical background of transport processes near the ground - a program system START which make possible the interactive calculation of human radiation exposure resulting from the accidental release of radioactivity from nuclear facilities into the atmosphere. The system supplies data relevant immediately after the release on the whole-body and thyroid exposure of adults caused by inhalation and γ-submersion.

46188 (SAAS—344, pp 25-34) **Investigations of the dispersion, concentration, and isotope ratio of aerosols of nuclear power plants in operation.** Vorob'ev, A.M.; Kochetkov, O.A.; Margulis, U.Ya.; Molokanov, A.A.; Tal'yanskij, E.D. 1986. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE87780163. (CONF-8509389—Pt.4).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

The content of radioactive aerosols in the air of rooms and stacks of the Rowensk nuclear power station fitted with WWER-440 reactors has been determined. Data are given for radioactive rare gases, carbon 14, and tritium. It is shown that the levels for gas-aerosol effluents of the unified WWER-440 reactor are much lower than permitted by safety standards.

46189 **Mound tritium stack air measurements - An update.** Sheehan, W.E.; Carter, D.C.; Rhinehammer, T.B. (Monsanto Research Corp. Mound, Miamisburg, OH 45342). pp 12.2 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Mound has excellent experience with this type of air monitoring. Trunk lines in addition to stacks are now being monitored by this technique to determine sources of tritium going to the stacks. Data generated by the bubblers are primarily used to document the total amount of tritium that is released to the environment and also its form (HTO/HT). For the past 10 yr, Mound has used air bubblers to quantify tritium stack gas effluents. This technique of using small-volume ethylene glycol bubblers in conjunction with a hot palladium sponge catalyst was initially reported in 1974 at this group's 20th meeting in Cincinnati, Ohio. In 1981, the original samplers were replaced with a second generation of units currently in use. The problems and some comments on certain aspects of liquid scintillation counting of ethylene-glycol-type samples are discussed.

46190 **The simultaneous determination of americium and plutonium by liquid scintillation counting.** Miglio, J.J.; Willis, L.C. (Los Alamos National Lab., Los Alamos, NM 87545). pp 11.2 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

A method for the simultaneous determination of americium and plutonium by liquid scintillation counting using a multichannel instrument is developed. The procedure utilizes a two-phase cocktail with plutonium in one phase and americium in the other phase. This new method is much faster than other liquid scintillation counting procedures which require two separate counts. In other methods, the total activity is determined in the first count. Using an extractant cocktail, one isotope is determined in the second count. The second isotope is determined by difference.

46191 **Bioassay for uranium mill tailings.** Tschaeche, A.N. pp 5.1 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Uranium mill tailings are composed of fine sand that contains, among other things, some uranium (U/sup 238/ primarily), and all of the uranium daughters starting with /sup 230/Th that are left behind after the usable uranium is removed in the milling process. Millions of pounds of tailings are and continue to be generated at uranium mills around the United States. Discrete uranium mill tailings piles exist near the mills. In addition, the tailings materials

were used in communities situated near mill sites for such purposes as building materials, foundations for buildings, pipe runs, sand boxes, gardens, etc. The Uranium Mill Tailings Remedial Action Project (UMTRAP) is a U.S. Department of Energy Program designed with the intention of removing or stabilizing the mill tailings piles and the tailings used to communities so that individuals are not exposed above the EPA limits established for such tailings materials. This paper discusses the bioassay programs that are established for workers who remove tailings from the communities in which they are placed.

46192 **New directions for measuring long-lived radionuclides in environmental and biological samples.** Beasley, T.M. (Environmental Research Div., Argonne National Lab.). pp 10.4 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Within the last decade, the use of high energy accelerators as mass spectrometers has advanced the capability for measuring certain long-lived radionuclides to unprecedented low levels. Where conventional mass spectrometry techniques can be applied to measuring these radionuclides, accelerator mass spectrometry techniques (AMS) can improve sensitivity by at least three orders of magnitude; isotope ratios (radioactive/stable) as low as 10/sup -15/ are determined for I-129. This increased sensitivity afforded by the AMS technique holds great promise in studying the partitioning of long-lived radionuclides within their stable element compartments in the biosphere/geosphere and the rates at which such partitioning occurs. Moreover, the use of certain long-lived radionuclides as tracers in both environmental and biological processes can be carried out using extremely small quantities of radioactive material thereby making radiation dosimetry considerations negligible. The AMS technique is briefly described and examples of measurements in bioassay, analytical and environmental radiochemistry are discussed.

46193 **Differential atmospheric tritium sampler.** Griesback, O.A.; Stencel, J.R. (Princeton Plasma Physics Lab., P.O. Box 451, Princeton, NJ 08544). pp 11.5 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

The "Differential Atmospheric Tritium Sampler" (DATS) is a passive, continuous duty air sampler, capable of differentially collecting tritium which may be in the form of water vapor (HTO) or tritium gas (T/sub 2/ and HT). It may be used for environmental monitoring, stack monitoring or for the determination of occupational exposure concentrations. Tritiated water vapor (HTO) is removed from sampled air by adsorption on silica gel or molecular sieve traps; tritium gas (HT/T/sub 2/) is combusted by a catalyst and then collected on another drying trap. Collection efficiency is determined for each sample run. For tritiated water vapor, the absence of an increase in the mass of trap "HTO-2" proves no "breakthrough" or essentially 100 percent collection efficiency. For tritium gas, the "water of combustion" mass divided by the theoretical water mass produced by the known amount of carrier gas fed to the catalyst, yields the combustion efficiency information of the catalyst. Rotometers used for determining the sampler's air flow and carrier gas supply are calibrated with a soap bubble spirometer (primary standard). The recovered sample is then mixed with a scintillation counting solution, dark-adapted for 24 hours, and then assayed for tritium activity by liquid scintillation spectrometry. Tritium enrichment procedure (alkaline electrolysis) is used on composites of samples to determine true background levels.

5006 Regulations

REFER ALSO TO CITATION(S) 44894, 45539, 45583, 46185

46194 **(IFEU—40) Material on dying forests: Effectiveness analysis of emission-reducing measures. Sulphur dioxide, nitrogen oxides.** Seeberger, J.; Teufel, D. (Institut fuer Energie- und Umweltforschung e.V., Heidelberg (Germany, F.R.)). May 1985. 72p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10652.

Using a specially developed programme for the purpose, the technical effectiveness of the measures already taken by the Federal Government and individual 'Laender' governments to counteract the death of forests and possible farther-reaching measures was studied. The study came to the following results: As far as nitrogen oxides are concerned, which, according to the majority of studies done in recent years, are the major cause of dying forests by forming photochemical smog, the next 8 years are not expected to bring any reduction of pollution. With regard to sulphur dioxide, a slight reduction can be expected in annual emissions in the coming years, but this does not mean that the problems caused by SO/sub 2/ will be reduced as well.

46195 **(IFEU—42) Development of pollutant emissions from motor vehicle traffic. Account of the effects of EC directives and tax incentives for low-pollution cars.** Hoepfner, U.; Schmidt, M.; Sontheimer, J.; Stotz, E.; Teufel, D.; Bittner, H.P. (Institut fuer Energie- und Umweltforschung e.V., Heidelberg (Germany, F.R.)). Nov 1985. 156p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-10651.

Taking into account various marginal conditions, emissions from car and van traffic and the development of traffic emissions as a whole were calculated for the next 15 years. According to this, nitrogen oxide emissions from traffic will drop only slightly in the coming years. Car and light van emissions of nitrogen oxide will fall by about 0.2 million tons from 1985-1995 and will then amount to approx. between 0.8 and 0.9 million tons p.a. The nitrogen oxide emissions occurring on federal motorways will remain relatively constant. The development in other groups of pollutants locks slightly more positive. By 1995, a reduction of about 39% can be forecast for hydrocarbons resulting from traffic emissions, and carbon monoxide emissions will be about 25% lower by that date.

46196 **(PB—87-205191/XAB) Example modeling to illustrate SIP (State Implementation Plan) development for the PM(10) NAAQS (National Ambient Air Quality Standards).** Anderson, M.K.; DeCesar, R.T.; Londergan, R.J.; Brookman, E.T. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). May 1987. 128p. NTIS, PC A07/MF A01.

The document provides an illustration of the use of modeling techniques for SIP development for the PM10 NAAQS. Available dispersion and receptor modeling techniques are applied, and their results are compared. Analyses applicable to both the annual and 24-hour PM10 NAAQS are demonstrated. The application of models in control-strategy development is described. The examples provided include an urban-area problem and a problem caused by an industrial source with fugitive dust.

46197 **(PB—87-208658/XAB) Pilot project to demonstrate the feasibility of a state continuous-emission-monitoring system (CEMS) regulatory program. Summary report.** Quarles, P.; Peeler, J.W. (Engineering-Science, Inc., Fairfax, VA (USA)). Jun 1986. 45p. NTIS, PC A03/MF A01.

The report describes a pilot project to demonstrate the feasibility of a State CEMS regulatory program in Missouri and Iowa. With the cooperation of the State agencies, EPA regional offices and major utility companies, the project successfully demonstrated the technical reliability of CEMS and the potential for successful CEMS program implementation in these States. The purpose of the report is to disseminate information on the pilot project findings and recommendations to other air-pollution agencies. The report summarizes the project approach and major findings and recommendations which resulted from the four-year study. Specific find-

ings include the technical feasibility of CEMS and the potential usefulness of CEMS's as a surveillance aid to a State air pollution control agency. Specific recommendations for CEMS program implementation include recommendations for excess emission report review, quality assurance, audits, and the use CEMS data by the utility industry.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

46198 (IC—86/358) Statistical model for horizontal mass flux of erodible soil. Babiker, A.G.A.G.; Eltayeb, I.A.; Hassan, M.H.A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703082.

It is shown that the mass flux of erodible soil transported horizontally by a statistically distributed wind flow has a statistical distribution. Explicit expression for the probability density function, p.d.f., of the flux is derived for the case in which the wind speed has a Weibull distribution. The statistical distribution for a mass flux characterized by a generalized Bagnold formula is found to be Weibull for the case of zero threshold speed. Analytic and numerical values for the average horizontal mass flux of soil are obtained for various values of wind parameters, by evaluating the first moment of the flux density function. 7 refs, 2 figs.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 44885, 44985, 44996, 45000, 45002, 45073, 45864, 45887, 45891, 46161, 46165, 46226, 46327

46199 (DOE/SR/15170—1) Kinetics and mechanisms of the release of trace inorganic contaminants to ground water from coal ash basins on the Savannah River Plant: Progress report, September 29, 1986-September 30, 1987. Sandhu, S.S.; Mills, G.L. (Claflin Coll., Orangeburg, SC (USA)). 15 Aug 1987. Contract FG09-86SR15170. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014066.

Undisturbed cores of ashes from the sites, randomly selected in the Old and New ash disposal basins, located in D-area on the Savannah River Plant were removed and sequentially extracted for the quantitative estimation of dissolved (pore water), exchangeable and Fe/Mn oxide associated trace inorganic contaminants (i.e., As, Cd, Cr, and Ni). The Ash samples were also analyzed for total P, K, Na, Ca, Mg, Al, Pb, Mn, Fe, B, Cu, Zn, and Mo. Sluiced water samples, at four locations in the new ash disposal basin, were tested for As, Ca, Cd, Cr, Fe, Mn, and Ni. Ground water samples from the bores, installed at the ash sampling sites were tested for As, Ca, Cd, Cr, Fe, Mn, and Ni. A very small fraction of the total elemental concentration, excepting Cd, were found in the dissolved phase. Most of the easily releasable elements in the ashes were found associated with Fe/Mn oxides. Analysis of the data clearly indicates the release and mobilization of trace contaminants to the lower horizons of the impounded ashes. Elemental translocation was found to be more serious in the old ash basins rather than the new ones.

46200 (UCRL—97152) The Hazardous Material Technician Apprenticeship Program at Lawrence Livermore National Laboratory. Steiner, S.D. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 11p. (CONF-8709100—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013489.

From Hazardous materials management conference and exhibition of Canada; Toronto, Canada (9 Sep 1987).

This document describes an apprenticeship training program for hazardous material technician. This entry-level category is achieved after approximately 216 hours of classroom and on-the-job training. Procedures for evaluating performance include in-class testing, use of on-the-job checks, and the assignment of an apprentice mentor for each trainee. (TEM)

46201 Air pollutants effects on forest ecosystems. St. Paul, MN; The Acid Rain Foundation Inc. (1985). 439p. The Acid Rain Foundation Inc., 1630 Blackhawk Hills, St. Paul, MN 55122.

This book presents the papers given at a conference on the effects of acid rain on forests. The conference was sponsored by the National Acid Precipitation Assessment Program (NAPAP). Topics considered at the conference included the status of US research on acid deposition and its effects contributing factors to the decline of forests, evidence for effects on ecosystems, the effects of air pollutants on forest ecosystems in North America and Europe, forest management, and future scientific research programs and management approaches.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 45121, 45126, 45132, 45135, 45139, 45140, 45146, 45148, 45151, 45153, 45278, 45485, 45486, 45487, 45854, 46161, 46186, 46190, 46192, 46200, 46227, 46228, 46229, 46230, 46231, 46232

46202 (CONF-871018—2) Automation of the radiological survey process: USRADS ultrasonic ranging and data system. Berven, B.A.; Blair, M.S.; Little, C.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010588.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Radiological Survey Activities (RASA) program at Oak Ridge National Laboratory (ORNL) serves as the Inclusion Survey Contractor (ISC) in the Department of Energy's (DOE) Uranium Mill Tailings Remedial Action project (UMTRAP). The ISC is to identify properties in the vicinity of 24 inactive uranium mill sites suspected of having ^{226}Ra-bearing uranium mill tailings by-product material originating from the processing of uranium ore contamination. Mobile gamma scanning was the primary method used to identify these properties. Once identified, the ISC conducts an inclusion survey. This survey performs sufficient radiological measurements to determine if uranium mill tailing contamination is present, and, if so, if it is in excess of relevant Environmental Protection Agency (EPA) criteria. Radon emanating from ^{226}Ra is the primary pathway of exposure to human occupants at these sites. EPA criteria focus on controlling ^{226}Ra concentration in soil. The concentration of ^{226}Ra in soil can be measured directly by soil sampling and subsequent gamma spectrographic analysis of the sample, or by direct measurement of the gamma exposure rate at the soil surface using portable instrumentation in the field. In both methods, the concentration of ^{226}Ra is inferred by examining the frequency of gamma emission of ^{214}Bi, a radioactive decay product in the ^{238}U decay chain.

46203 (CONF-871018—3) Estimating volume of contaminated soil for excavation: A quick and simple method. Robinet, M.J.; Wynveen, R.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011362.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Estimates of the volume of radionuclide contaminated soil which must be excavated require data on the depth distribution of the contamination. Using a novel uncomplicated approach, vertical activity distribution data were obtained on a 1400 m^2 site. The volume of contaminated soil which had to be excavated was estimated to be between 227 and 425 m^3. When the site cleanup was done, 312 m^3 of contaminated soil had to be removed to satisfy the cleanup criteria. The basic approach was to drill 193 holes over the entire site and to make measurements in each using a detector with a side-looking collimator. Soil samples from the holes were analyzed only to the extent necessary to obtain sufficient data for demonstrating a correlation between count rate and activity concentration in the soil. The site was then conceptually sliced into vertical strips of contamination concern. The product of the contamination depths which exceeded cleanup criteria and the areas of the slices gave the volume of excavation required.

46204 **(ISH—103) Consequences of the Chernobyl reactor accident for the Munich area.** Schwibach, J. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Nov 1986. 64p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10664.

The radiological effects were detectable since April 30, 1986, measurements revealed a fallout of about 400 kBq/m/sup 2/ of gamma-ray emitters, consisting a.o. of 70 kBq/m/sup 2/ of I-131 and 30 kBq/m/sup 2/ of Cs-134 and Cs-137. The gamma dose rate in open air increased to about 1 μSv/h (i.e. twelve times the natural background). Contamination of grass-lands and green-leaf vegetables in May was measured to be about 20.000 Bq/kg of I-131, and some 1000 Bq/kg of Cs-134 and Cs-137. I-131 nuclides in fresh milk accounted for a contamination of 100-1.000 Bq/l. In meat, some 100 Bq/kg of Cs-134 and Cs-137 were peak values. The reference value set for milk was 500 Bq/l of I-131, and for green-leaf vegetables 250 Bq/kg of I-131. This meant that sales of milk had to be restricted, and the harvest of contaminated vegetables completely dumped. Prognostic dose values calculated for the year 1986 are: Thyroid dose to infants, about 10 mSv (1 rem); effective dose to adults and children induced by all possible sources, about 0.5 mSv (50 mrem), but 1 mSv (100 mrem) as a maximum. Whole-body countings indicated a mean radiation dose to persons living in the Munich area of about 3 mSv (300 mrem) thyroid dose to children from I-131, and about 0.1 mSv (10 mrem) effective dose to children from I-131, and about 0.05 mSv (5 mrem) to children and adults from the incorporation of Cs-134 and Cs-137. There was no accute health hazard to the population, and all values measured were within the intensities and fluctuation margins of the natural radiation exposure.

46205 **(PB—87-190070/XAB) Superfund Record of Decision (EPA Region 8): Denver Radium/ROBCO, Colorado (second remedial action), September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 38p. (EPA/ROD/R—08-86/009). NTIS, PC A03/MF A01.

The Denver Radium/ROBCO site is located on the site of the former National Radium Institute (NRI) facility, a private corporation operating between 1914 and 1920 which produced radium under an agreement with the U.S. Bureau of Mines. Research revealed the ROBCO property as one of thirty-one radioactive sites in the Denver metropolitan area. There is no serious public health risk at present from the radon gas and its decay products found onsite. However, since radium has a half-life of 1600 years, there is a long-term potential for increased public health risk if the radium-contaminated materials were misused or inadvertently spread. An EPA preferred alternative, full removal and permanent offsite disposal, is proposed but is very costly. Therefore, the EPA is actively pursuing a temporary offsite storage remedy.

46206 **(SAND—87-1916) Description and procedures of the Environmental Radiation Dosimetry Program.** Thompson, D.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013655.

Thermoluminescent dosimeters (TLDs) are used to monitor environmental ionizing radiation background levels at the area surrounding the research facilities at Sandia National Laboratories in Albuquerque, New Mexico; the Kirtland, Air Force Base perimeter; the area within the city of Albuquerque; and the area that surrounds the city of Albuquerque. This report describes the TLD package and equipment, and the handling and readout procedures used in the SNLA Environmental TLD Program. 3 refs., 3 figs.

46207 **Comparison of dissolution techniques for various natural matrix standards.** Harvey, J.T. (Plant Lab., Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., Oak Ridge, TN 37831). pp 7.2 of Proceedings of the 32nd annual conference on bioassay, analytical and environmental radiochemistry. Gaithersburg, MD; National Bureau of Standards (1986). (CONF-861022—Absts.).

From 32. annual conference on bioassay, analytical and environmental chemistry; Gaithersburg, MD, USA (21 Oct 1986).

Recent information has shown inconsistencies in the results for some radionuclides in the natural matrix standards that are most likely traceable to the methods of dissolution, including incomplete equilibration of the yield monitor with the sample. This paper investigates four natural matrix standards (NBS 4350B, Columbia River Sediment; NBS 4353, Rocky Flats Soil No. 1; NBS 4355, Peruvian Soil; and the yet-to-be-issued Irish Sea Sediment) analyzed by standard radiochemical techniques using four different sample dissolution methods. Preliminary results of the various radiochemical analysis are presented and discussed. Where the results are available, comparisons between the bulk and individual methods of preparation are presented for discussion. Discussion is also given to the relative merits (difficulty, cost, etc.) of the methods used.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 44885, 44886, 44887, 44931, 45122

46208 **(EGG—10282-2166) Biological survey of Naval Petroleum Reserve No. 2 (Buena Vista), Kern County, California.** O'Farrell, T.P.; Sauls, M.L. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Jun 1987. Contract AC08-83NV10282. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87014218.

A field survey of Naval Petroleum Reserve No. 2, Kern County, California, was conducted to determine the distribution and relative abundance of endangered species and other wildlife. Of the 343 San Joaquin kit fox dens found in 40 sections, 33 were observed by surveyors in transit and 310 were found along transects. Of the latter, 264 were typical subterranean dens and 46 were atypical dens in man-made structures. Estimated density of dens was 28.8 +- 4.4 per square mile; relative density was 9.2/1000 acres. The number of typical dens observed per section was inversely correlated with the number of petroleum wells per section (intensity of development). Atypical dens were usually found to be in pipes or pipe culverts and were positively correlated with density of wells. Relative densities of black-tailed jackrabbits (41.9/1000 acres) and desert cottontails (17.1/1000 acres), preferred prey for foxes, were high compared with densities reported on other public lands. Most (81%) of the 19 blunt-nosed leopard lizards were observed in six adjacent sections located in the gentle foothills near Buena Vista Lake playa. Most (86%) of the 275 giant kangaroo rat burrow systems were observed in ten sections containing flat, relatively undeveloped terrain in and around upper Buena Vista Valley. San Joaquin antelope ground squirrels were the second most commonly observed diurnal vertebrate: 761 observations in 45 sections. A total of 6740 observations of 61 species of wildlife were made.

5106 Regulations

REFER ALSO TO CITATION(S) 45148, 45539, 46205, 46237, 46238, 46711

46209 **(PB—87-188397/XAB) Superfund Record of Decision (EPA Region 4): Pioneer Sand Company, Warrington, Florida, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Sep 1986. 100p. (EPA/ROD/R—04-86/016). NTIS, PC A05/MF A01.

The Pioneer Sand site, owned by the Pioneer Sand Company (PSC), is an inactive 11-acre quarry located near Belleview, FL. A disposal permit granted to PSC in 1974 allowed the disposal of inert materials including construction debris and shredded automobile strippings. Between 1974 and 1978, phenols and resin compounds were deposited from Newport Industries (currently Reichhold Chemical Company). Domestic and industrial wastes including metal plating sludges were also received from the Pensacola Naval Air Station. In 1981 the Florida Department of Environmental Regulation did not renew the disposal permit and ordered the waste-dumping practices to cease. Based on the RI results for PCB analysis of soils at the site, the EPA conducted an Immediate Removal Action in August 1986. All known areas of PCB concentrations greater than 50 ppm were removed. The primary contaminants of concern include: VOCs, organics, heavy metals, phenols, phthalates, and toluene.

46210 **(PB—87-189437/XAB) Superfund Record of Decision (EPA Region 5): Arrowhead Refinery, Duluth, Minnesota, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 76p. (EPA/ROD/R—05-86/044). NTIS, PC A05/MF A01.

The Arrowhead Refinery site is located in Hermantown, St. Louis County, Minnesota. The operation generated waste by-products that were discharged into an uncontained 2-acre lagoon and a waste-water ditch in a wetland area. Investigations conducted by EPA in 1979 revealed that onsite surface water was transporting contaminants to nearby wetlands areas and navigable waters. The primary contaminants of concern are VOCs, PAHs, and lead, and they are found in onsite soils, sediments, surface waters, and ground water. The selected remedial action for the Arrowhead Refinery site are cited.

46211 **(PB—87-190005/XAB) Superfund Record of Decision (EPA Region 6): Sikes Disposal Pits, Crosby, Texas, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 18 Sep 1986. 59p. (EPA/ROD/R—06-86/013). NTIS, PC A04/MF A01.

The Sikes Disposal Pits site is bordered by the San Jacinto River on the west, Jackson Bayou on the north, and U.S. Highway 90 on the south. Chemical wastes from area petrochemical industries and numerous drums were deposited onsite in several old sand pits. A preliminary sampling at the site indicated the presence of phenolic compounds and other organics. A removal action by the EPA removed approximately 440 cubic yards of phenolic tars from a partially buried pit. Subsequent studies at the site indicated the need for a total remedial site plan. The primary contaminants of concern include: organics, toluence, creosote, benzene, xylene, phenolic compounds, halides, dichloroethane, vinyl chloride. Remedial action is proposed and included in the report.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 44928, 44997, 44998, 44999, 45001, 45223, 46250

46212 **(DOE/ER/60301—5) Pathogenic regulation of running water macroinvertebrate populations: Progress report.** Cummins, K.W.; Wilzbach, M.A. (Maryland Univ., Frostburg (USA). Appalachian Environmental Lab.). 1987. Contract FG05-85ER60301. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014282.

The emphasis was on the interaction between food quality and growth of representatives of the shredder, collector and scraper functional groups. However, extensive effort also was directed toward aspects of invertebrate mortality in a range of studies during the project period. Three procedures were developed for separating populations of stream macroinvertebrates into groups of individuals which exhibit differential mortality. The differences in survival observed in these population components, are not due to predation, starvation, competition or obvious physical damage or chemical insult. Based on our preliminary experiments and observations, we hypothesize that the major cause of mortality is pathogenic infection, particularly by anaerobic bacteria. The suspected pathogens are routinely present in the digestive tracts of stream invertebrates. Infection is most likely to occur at molting, the specific sites of infection probably being lesions developing at the junction of the midgut and hindgut when the lining of the hindgut is shed.

46213 **(DOE/ER/60311—3) Nutrient recycling on the southeastern US Continental Shelf: Progress report.** Hanson, R.B. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Aug 1987. Contract FG09-85ER60311. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014067.

During the 1986-1987 contract year, time was spent on: (1) synthesizing nitrogen recycling data obtained as part of the SPREX experiment; (2) describing bacterioplankton dynamics observed as part of SPREX and Pre-SPREX; (3) determining nitrogen recycling in very nearshore waters (scheduled R/V Blue Fin cruises); (4) determining nitrogen recycling rates during the winter (GALE); (5) attending organizational meetings and preparing for the FLEX experiment; and (6) determining nitrogen recycling rates (scheduled R/V Blue Fin cruises) in coastal sediments. Major conclusions from SPREX nitrogen recycling experiments are: (1) NH4+ regeneration could support 29 to 127% of the measured primary production; however, U : R ratios indicate that only 50% of the NH4+ was biologically and chemically accounted for and the remaining was lost ("vanishing nitrogen" paradox); and (2) NH4+ assimilation was 10 to 20% of measured photosynthesis. Our results suggest that alternative sources of nitrogen are required to meet the nitrogen demand of the coastal phytoplankton and sinks of nitrogen (NH4+) during SPREX.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 44923, 44924, 44925, 44926, 44927, 44929, 44930, 44931, 44985, 44996, 45003, 45004, 45005, 45027, 45061, 45062, 45063, 45064, 45066, 45070, 45073, 45120, 45153, 45324, 45887, 45891, 46161, 46236, 46312, 46313, 46314, 46315, 46316, 46321, 46327, 46341

46214 **(AD-A—181345/0/XAB) Wastewater characterization and hazardous-waste survey, Hickam AFB, Hawaii. Final report, 13-27 January 1987.** Binovi, R.D.; Tetla, R.A.; Slavich, F.E. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). May 1987. 89p. (USAFOEHL—87-064EQ0688EEF). NTIS, PC A05/MF A01.

The USAFOEHL characterized the industrial wastewater in the Hickam AFB sewers and conducted a hazardous-waste survey. The scope of the survey included characterizing the major industrial wastewater discharges from the base and determining if applicable discharge standards are being violated. A total of 23 sampling sites were evaluated including 10 lift stations and 10 oil/water separators. The hazardous-waste survey included visiting 44 shops to determine chemical usage and hazardous-materials management practices including collection, storage, disposal practices and accumulation points.

46215 **(AD-A—181346/8/XAB) Wastewater characterization survey, Plattsburgh AFB, New York. Final report.** Binovi, R.D.; Riojas, A.H.; Spakowicz, M.R. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). May 1987. 89p. (USAFOEHL—87-062EQ0159EEF). NTIS, PC A05/MF A01.

The USAFOEHL conducted a survey characterizing the wastewater in the Plattsburgh AFB sanitary, storm, and surface-water discharges from the base and determining if applicable discharge standards are being violated. A total of 31 sampling sites were evaluated including 12 sanitary, 13 surface, and 6 storm-water sources. Priority pollutants were found in samples from the sanitary and storm sewers and in the streams leaving the base. Recommendations were: (1) Combustible-gas detection sytems should be installed in lift stations. (2) A comprehensive hazardous-waste survey should be conducted to identify the source of the contaminants. (3) Respirators should be worn by personnel entering the wet well of lift stations, Building 2291. (4) Alternates for achieving better oil/water separation should be investigated. (5) The possibility of cross connections between the sanitary and storm systems should be investigated. (6) Oil/water separators discharge should be determined and should be connected to the sanitary sewer system. (7) Streams should be monitored for ammonia to avoid aquatic toxicity problems. (8) The BOD/COD ration should be determined by monitoring these parameters in the stream flowing through Copeland Oil property. (9) Additional analysis should be conducted on the seepage from the marina beach area. (10) A hazardous-material training program should be instituted.

46216 (FLPU—85-4) Computer codes for three dimensional mass transport with non-linear sorption. Noy, D.J. (British Geological Survey, Keyworth. Fluid Processes Research Group). Mar 1985. 22p. Natural Environment Research Council, British Geological Survey, Keyworth, Notts, England NG12 5GG. File Number TI87900964.

This report describes the mathematical background and data input to finite element programs for three dimensional mass transport in a porous medium. The transport equations are developed and sorption processes are included in a general way so that non-linear equilibrium relations can be introduced. A three parameter isotherm is described as an example of the way that sorption data might be fitted and used in the programs. The programs themselves, which are designed to link with earlier groundwater flow programs (Noy, 1982), are then described and a guide given to the construction of the required input data sets. Concluding remarks indicate that the calculations require substantial computer resources and suggest that comprehensive preliminary analysis with lower dimensional codes would be important in the assessment of field data.

46217 (N—87-24031) Spatial characterization of acid rain stress in Canadian Shield lakes. Progress report, 1 August 1985-1 February 1986. Tanis, F.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). 1986. 9p. (NASA-CR—180983; NAS—1.26:180983; ERIM—198400-19-L). NTIS, PC A02/MF A01.

The acidification of lake waters from airborne pollutants is of continental proportions both in North America and Europe. A major concern of the acid rain problem is the cumulative ecosystem damage to lakes and forest. The number of lakes affected in northeastern United States and on the Canadian Shield is though to be enormous. The principle objective is to examine how seasonal changes in lake water transparency are related to annual acidic load. Further, the relationship between variations in lake acidification and ecophysical units is being examined. Finally, the utility of Thematic Mapper (TM) based observations to measure seasonal changes in the optical transparency in acid lakes is being investigated.

46218 (N—87-24040) Transport and photochemical modeling. Studies of atmospheric species. Natarajan, M. (ST Systems Corp., Hampton, VA (USA)). Mar 1987. 28p. (NASA-CR—178311; NAS—1.26:178311). NTIS, PC A03/MF A01.

A program of research studies related to the photochemistry, radiative transfer, and dynamics of the stratosphere is described. Investigations were conducted in two broad areas: (1) studies of the stratospheric processes and their response to external perturbations, and (2) analysis of satellite measurements in conjunction with theoretical models. Contemporary one dimensional photochemical, radiative-convective model was used to assess the impact of perturbations such as solar flux variability, increases in atmospheric carbon dioxide, chlorofluoromethanes and other greenhouse gases. Data from satellite experiments such as LIMS and SBUV, were used along with theoretical models to develop a climatology of trace species in the stratosphere. The consistency of contemporary ozone photochemistry was examined in the light of LIMS data. Research work also includes analysis of stratospheric nitrogen dioxide distributions from different satellite experiments, investigation of the wintertime latitudinal gradients in NO_2, estimation of the stratospheric odd nitrogen level and its variability, and studies related to the changes in ozone in the Antarctic, and midlatitude Southern Hemisphere.

46219 (PB—87-193298/XAB) National surface-water survey: Eastern Lake Survey, Phase 1 (ELS-1), 1984 (sas data tape). Data file. Landers, D.; Blick, J. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1986. mag tap. (EPA—600/4-86/007G). NTIS CP T03.

See also PB—87-110383, PB—87-110391, PB—87-110409, PB—87-193306, PB—87-193314, PB—87-193322, and PB—87-193330; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

The Eastern Lake Survey-Phase I (ELS-I), conducted in the fall of 1984, was the first part of a long-term effort by the U.S. Environmental Protection Agency known as the National Surface Water Survey. It was designed to synoptically quantify the surface-water quality of the United States in areas expected to exhibit low buffering capacity. This effort was in support of the National Acid Deposition Assessment Program. The Survey involved a three-month field effort in which 1612 probability-sample lakes and 186 special-interest lakes in the northeast, southeast, and upper-midwest regions of the United States were sampled. The data base supporting this effort was designed and data management was implemented by the Environmental Sciences Division of the Oak Ridge National Laboratory. The document provides the information necessary for researchers to transfer the ELS-I data base accurately to their own computer systems. A data dictionary, this document also includes complete descriptions of the variables in the data base and of the data-set formats. This data file is in the SAS format.

46220 (PB—87-193306/XAB) National surface water survey: Eastern Lake Survey, Phase 1 (ELS-1), 1984 (SAS export data tape). Data file. Landers, D.; Blick, J. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1986. mag tap. (EPA—600/4-86/007D). NTIS CP T03.

See also PB—87-110383, PB—87-110391, PB—87-110409, PB—87-110375, PB—87-193298, PB—87-193314, PB—87-193322, and PB—87-193330; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

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46221 (PB—87-193314/XAB) National surface water survey: Eastern Lake Survey, Phase I (ELS-1), 1984 (EBCDIC tape). Data file. Landers, D.; Blick, J. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1986. mag tap. (EPA—600/4-86/007F). NTIS CP T03.

See also PB—87-110383, PB—87-110391, PB—87-110409, PB—87-110375, PB—87-193298, PB—87-193306, PB—87-193322, and PB—87-193330; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

The Eastern Lake Survey-Phase I (ELS-I), conducted in the fall of 1984, was the first part of a long-term effort by the U.S. Environmental Protection Agency known as the National Surface Water Survey. It was designed to synoptically quantify the surface-water quality of the United States in areas expected to exhibit low buffering capacity. This effort was in support of the National Acid Deposition Assessment Program. The Survey involved a three-month field effort in which 1612 probability-sample lakes and 186 special-interest lakes in the northeast, southeast, and upper-midwest regions of the United States were sampled. The data base supporting this effort was designed and data management was implemented by the Environmental Sciences Division of the Oak Ridge National Laboratory. This document provides the information necessary for researchers to transfer the ELS-I data base accurately to their own computer systems. A data dictionary, this document also includes

complete descriptions of the variables in the data base and of the data-set formats.

46222 (PB—87-193322/XAB) National surface water survey: Eastern Lake Survey, Phase 1 (ELS-1), 1984 (ASCII tape). Data file. Landers, D.; Blick, J. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1986. 1p. (EPA—600/4-86/007E). NTIS CP T03.

See also PB—87-110383, PB—87-110391, PB—87-110409, PB—87-110375, PB—87-193298, PB—87-193306, PB—87-193314, PB—87-193330; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

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46223 (PB—87-193330/XAB) National surface water survey: Eastern Lake Survey, Phase 1 (ELS-1), 1984 (for microcomputers). Data file. Landers, D.; Blick, J. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1986. vp. (EPA—600/4-86/007I). NTIS CP D05.

See also PB—87-110383, PB—87-110391, PB—87-110409, PB—87-110375, PB—87-193298, PB—87-193306, PB—87-193314, and PB—87-193322; The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC microcomputer. The diskettes are in the ASCII format.

The Eastern Lake Survey-Phase I (ELS-I), conducted in the fall of 1984, was the first part of a long-term effort by the U.S. Environmental Protection Agency known as the National Surface Water Survey. It was designed to synoptically quantify the surface water quality of the United States in areas expected to exhibit low buffering capacity. This effort was in support of the National Acid Deposition Assessment Program. The Survey involved a three-month field effort in which 1612 probability sample lakes and 186 special-interest lakes in the northeast, southeast, and upper midwest regions of the United States were sampled. The data base supporting this effort was designed and data management was implemented by the Environmental Sciences Division of the Oak Ridge National Laboratory. This document provides the information necessary for researchers to transfer the ELS-I data base accurately to their own computer systems. A data dictionary, this document also includes complete descriptions of the variables in the data base and of the data set formats.

46224 (PB—87-201067/XAB) Incineration of water pollutants with activated char from coal, wood, or crop residues in a system designed to produce energy and pyrolysis by-product chemicals. Final Technical completion report (Final). Manahan, S.E.; Gale, R.W.; Laquer, F.C.; Smith, K.E.; Bornhop, D.J. (Missouri Univ., Columbia (USA). Dept. of Chemistry). 18 Nov 1982. 17p. NTIS, PC A02/MF A01.

A wastewater-treatment system, particularly useful for treating chemical leachates, was developed on a laboratory scale. Subbituminous coal, 20-60-mesh, was pyrolyzed. A synthetic wastewater containing 3520 ppm total organic carbon was contacted with non-activated char, char activated in water-saturated nitrogen at 850°C, and coal ash. During a contact time of 0.5 hour, organic removals from the wastewater were 13.3% by nonactivated char, 38.8% by activated char, and 46.5% by ash. For a contact time of 72 hours, organic removals were about 25% for nonactivated char, 58.8% for activated char, and 53.4% for ash. This treatment system is applicable where large amounts of waste carbonaceous material (coal, wood, crop residues) are available. The spent char can be incinerated. Heat from incineration can be used in the pyrolysis step, and the coal ash can be recycled to the water-purification step.

46225 (PB—87-201521/XAB) Processes affecting subsurface transport of leaking underground-storage-tank fluids. Tyler, S.W.; Whitbeck, M.R.; Kirk, M.W.; Hess, J.W.; Everett, L.G. (Nevada Univ., Las Vegas (USA). Water Resources Center). Jun 1987. 87p. NTIS, PC A05/MF A01.

The document focuses solely on the process affecting migration of fluids from a leaking tank and their effects on monitoring methodologies. Based upon the reviews presented, soil heterogeneities and the potential for multiphase flow will lead to high monitoring uncertainties if leak-detection systems rely on liquid-sampling alone. Vapor transport is also affected by these properties although to a lesser degree. More research is needed, however, to better understand the physics of vapor transport. Vapor transport of contaminants to the monitoring sensors will also be strongly affected by the volatility of the fluid. Difficulties in detection and monitoring systems may also be generated from fluid interactions with the soil and microbes. The processes of adsorption, partitioning, and microbial alteration of fluids in the subsurface may have strong effects on the uncertainty of monitoring systems. These fate processes have received less attention than liquid and vapor transport processes and will require significantly more research before their effects are fully understood.

46226 (PB—87-203386/XAB) Detection of a microbial consortium, including type 2 methanotrophs, by use of phospholipid fatty acids in an aerobic halogenated hydrocarbon-degrading soil column enriched with natural gas. Nichols, P.D.; Henson, J.M.; Antworth, C.P.; Parsons, J.; Wilson, J.T. (Florida State Univ., Tallahassee (USA). Dept. of Biological Science). 1987. 12p. NTIS, PC A02/MF A01.

Pub. in Environmental Toxicology and Chemistry, Vol. 6, 89-97(1987).

The phospholipid ester-linked normal and lipopolysaccharide-layer hydroxy fatty acids from microbes in a natural gas (85% methane)-stimulated soil column capable of degrading halogenated hydrocarbons were analyzed in detail by capillary column GC-MS. Microbial biomass, calculated from phospholipid fatty acid (PLFA) concentrations to be 5.6 x 10^9 bacteria/g (dry weight), was greater in the hydrocarbon-degrading column than in either an azide-inhibited soil column or an untreated surface soil. Microbial community structure information, using GC-MS analysis of derivatized monounsaturated PLFA, indicated that the major component (16 to 18%) of the PLFA in the hydrocarbon-degrading column was the PLFA 28:1 delta 10c. The novel PLFA has been reported as a major component in type II methanotrophs. Based on these differences, the potential exists to use these methods to monitor shifts in microbial biomass and community structure in aquifers where indigenous bacteria are stimulated to biotransform pollutant compounds.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 45115, 45120, 45126, 45132, 45135, 45138, 45139, 45153, 45954, 46161, 46190, 46192, 46202, 46207

46227 (NUREG/CR—4615-Vol.2, pp 4-36) **Analysis and predictions of water and solute transport in a large lysimeter.** van Genuchten, M.Th.; Parker, J.C.; Kool, J.B. (Salinity Lab., Riverside, CA). Apr 1987. NTIS, PC A11/MF A01 - GPO. File Number TI87009181. (LA—10730-MS-Vol.2; CONF-8606304—Vol.2).

From Workshop on modeling of solute transport in the unsaturated zone; Los Alamos, NM, USA (19 Jun 1986).

The use of simple deterministic models to describable the flow and transport behavior of crushed Bandelier Tuff in large lysimeters has been investigated. The results for iodine, lithium, bromine, and strontium tracer experiments were analyzed using selected analytical and numerical solutions of the classical deterministic convection-dispersion equation for steady flow in an assumed uni-

form velocity field. In addition the hydraulic behavior of Bandelier Tuff was evaluated. In many respects the simple flow models provided adequate descriptions of the observed behavior, however, considerable variability of flow and transport behavior occurs and complicates the descriptions and predictions of the processes involved.

46228 (NUREG/CR—4615-Vol.2, pp 37-81) **Simulation of ion movement in soil using a continuous-time Markov process.** Knighton, R.E.; Wagenet, R.J. (North Dakota State Univ., Fargo). Apr 1987. NTIS, PC A11/MF A01 - GPO. File Number TI87009181. (LA—10730-MS-Vol.2; CONF-8606304—Vol.2).

From Workshop on modeling of solute transport in the unsaturated zone; Los Alamos, NM, USA (19 Jun 1986).

Simulation of solute transport using a continuous-time Markov process is a new approach for modeling chemical movement in soils. The authors describe the model and apply it to the results of tracer experiments on the transport of iodine, bromine, strontium and lithium in Bandalier tuff. The model successfully describes most of the data but was not able to simulate strontium displacement in the current study. The reasons for this are not clear.

46229 (NUREG/CR—4615-Vol.2, pp 82-116) **Time and frequency domain analysis of tracer migration in crushed tuff.** Duffy, C.J.; Al-Hassan, S. (Utah State Univ., Logan). Apr 1987. NTIS, PC A11/MF A01 - GPO. File Number TI87009181. (LA—10730-MS-Vol.2; CONF-8606304—Vol.2).

From Workshop on modeling of solute transport in the unsaturated zone; Los Alamos, NM, USA (19 Jun 1986).

The time moment method as presented by Valocchi (1985) and Himmelbau (1970) is compared with the frequency domain method for transport parameter estimation for the LANL caisson experiments. Parameters for several tracers are estimated and compared using the time and frequency domain methods. Descriptions of the models are given. Some speculation is presented regarding the nature of local and macrodispersive effects in the experiment, including some indication concerning the effect of uncertainty in the velocity, source strength, and random measurement errors on the overall interpretation of the experiment. Descriptions of the models are given.

46230 (NUREG/CR—4615-Vol.2, pp 117-173) **Finite element simulation of moisture movement and solute transport in a large caisson.** Huyakorn, P.S.; Jones, B.G.; Parker, J.C.; Wadsworth, T.D.; White, H.O. Jr. (GeoTrans, Inc., Herndon, VA). Apr 1987. NTIS, PC A11/MF A01 - GPO. File Number TI87009181. (LA—10730-MS-Vol.2; CONF-8606304—Vol.2).

From Workshop on modeling of solute transport in the unsaturated zone; Los Alamos, NM, USA (19 Jun 1986).

The results of the solute transport experiments performed on compacted, crushed Bandelier Tuff in caisson B of the experimental cluster described by DePoorter (1981) are simulated. Both one- and three-dimensional simulations of solute transport have been performed using two selected finite element codes. Results of bromide and iodide tracer experiments conducted during near-steady flow conditions have been analyzed for pulse additions made on December 6, 1984, and followed over a period of up to 60 days. In addition, a pulse addition of nonconservative strontium tracer on September 28, 1984, during questionably steady flow conditions has been analyzed over a period of 240 days. One-dimensional finite element flow and transport simulations were carried out assuming the porous medium to be homogeneous and the injection source uniformly distributed. To evaluate effects of the nonuniform source distribution and also to investigate effects of inhomogeneous porous medium properties, three dimensional finite element analyses of transport were carried out. Implications of the three-dimensional effects for the design and analysis of future tracer studies are discussed.

46231 (NUREG/CR—4615-Vol.2, pp 174-199) **Panel summary report.** Gutjahr, A.L.; Kincaid, C.T.; Mercer, J.W.; Murarka, I.P.; Siegel, M.D.; Wierenga, P.J. (New Mexico Institute of Mining and Technology, Socorro). Apr 1987. NTIS, PC A11/MF A01 - GPO. File Number TI87009181. (LA—10730-MS-Vol.2; CONF-8606304—Vol.2).

From Workshop on modeling of solute transport in the unsaturated zone; Los Alamos, NM, USA (19 Jun 1986).

The objective of this report is to summarize the various modeling approaches that were used to simulate solute transport in a variably saturated emission. In particular, the technical strengths and weaknesses of each approach are discussed, and conclusions and recommendations for future studies are made. Five models are considered: (1) one-dimensional analytical and semianalytical solutions of the classical deterministic convection-dispersion equation (van Genuchten, Parker, and Kool, this report); (2) one-dimensional simulation using a continuous-time Markov process (Knighton and Wagenet, this report); (3) one-dimensional simulation using the time domain method and the frequency domain method (Duffy and Al-Hassan, this report); (4) one-dimensional numerical approach that combines a solution of the classical deterministic convection-dispersion equation with a chemical equilibrium speciation model (Cederberg, this report); and (5) three-dimensional numerical solution of the classical deterministic convection-dispersion equation (Huyakorn, Jones, Parker, Wadsworth, and White, this report). As part of the discussion, the input data and modeling results are summarized. The models were used in a data analysis mode, as opposed to a predictive mode. Thus, the following discussion will concentrate on the data analysis aspects of model use. Also, all the approaches were similar in that they were based on a convection-dispersion model of solute transport. Each discussion addresses the modeling approaches in the order listed above.

46232 (PB—87-204822/XAB) **Fate and bioaccumulation of soil-associated low-level naturally occurring radioactivity following disposal into a marine ecosystem. Final report.** Hunt, C.D. (Rhode Island Univ., Narragansett (USA). Marine Ecosystems Research Lab.). 1 Oct 1986. 169p. NTIS, PC A08/MF A01.

The fate of radium (Ra) and other naturally occurring uranium-series isotopes associated with soils disposed in seawater was examined using the Marine Ecosystem Research Laboratory (MERL) controlled marine ecosystems. Thirty-seven kilograms of a soil containing approximately 400 pCi Ra-226/g from an inactive uranium ore processing plant site in Middlesex, New Jersey, were added to each of two mesocosms over five days in mid-September 1984. Radionuclide activity in these and two control mesocosms was observed for three months after the soil additions. Radioactivity in the soil appeared to be confined to discrete soil particles rather than being distributed equally on the soil particles, suggesting the source of the radioactivity was remnant ore particles.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 45115, 45224, 45225

46233 (DP-MS—87-15) **Correlation between aircraft MSS and LIDAR remotely sensed data on a forested wetland in South Carolina.** Jensen, J.R.; Hodgson, M.E.; Mackey, H.E. Jr.; Krabill, W. (South Carolina Univ., Columbia (USA). Dept. of Geography; Savannah River Lab., Aiken, SC (USA); National Aeronautics and Space Administration, Wallops Island, VA (USA). Wallops Station). 1987. Contract AC09-76SR00001. 42p. (CONF-871098—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011229.

From Fall convention of the American Society of Photogrammetry and remote sensing; Reno, NV, USA (4 Oct 1987).

Wetlands in a portion of the Savannah River swamp forest, the Steel Creek Delta, were mapped using April 26, 1985 high-resolution aircraft multispectral scanner (MSS) data. Due to the complex spectral characteristics of the wetland vegetation, it was necessary to implement several techniques in the classification of the MSS imagery of the Steel Creek Delta. In particular, when performing unsupervised classification, an iterative "cluster busting"

technique was used which simplified the cluster labeling process. In addition to the MSS data, light detecting and ranging (LIDAR) data were acquired by National Aeronautics and Space Administration (NASA) personnel along two flightlines over the Steel Creek Delta. These data were registered with the wetland classification map and correlated. Statistical analyses demonstrated that the laser derived canopy height information was significantly correlated with the Steel Creek Delta wetland classes encountered along the profiling transect of the LIDAR data.

46234 **(LA—11046-PR) Water supply at Los Alamos during 1986: Progress report.** Purtymun, W.D.; Stoker, A.K.; Maes, M.N. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87012297.

Water supply operations during 1986 were satisfactory with municipal and industrial usage supplied by 1497 x 10^6 gal from wells in three well fields and 28 x 10^6 gal from the spring gallery in Water Canyon. About 2.4 x 10^6 gal of water from Guae Reservoir and 1.5 x 10^6 gal from Los Alamos Reservoir were used for irrigation; thus the total water usage in 1986 was about 1529 x 10^6 gal. The total water usage was down in 1986 about 99 x 10^6 gal from the total usage of 1628 x 10^6 gal in 1985. Primary and secondary chemical quality of water in the distribution system was in compliance with federal regulations.

46235 **(NP—7900981) The St. Marys River, Michigan: An ecological profile.** Duffy, W.G.; Batterson, T.R.; McNabb, C.D. (National Wetlands Research Center, Slidell, LA (USA); Michigan State Univ., East Lansing (USA). Dept. of Fisheries and Wildlife). May 1987. 154p. U.S. Fish & Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. File Number TI87900981.

St. Marys River, the single outlet from Lake Superior, flows between Michigan and Ontario and has formed the International Border between the United States and Canada since 1783. Although the riverbed and a major rapids system have been modified to accommodate commercial navigation and for hydroelectric generation, the St. Marys River retains more of its biological and physicochemical integrity than any other Laurentian Great Lakes connecting channel. This oligotrophic lake's cold, well-oxygenated water contributes >90% of the river's annual flow and has a major influence on the evolution of its biological communities. This monograph reviews the published and unpublished ecological information available for the St. Marys River. The authors begin by reviewing the geologic history, human exploration, and settlement of the region, then proceed to a description of the physical and chamical characteristics of the river. The third chapter describes the biological communities presently inhabiting the river. A fourth chapter synthesizes ecological relationships within the river, emphasizing detrital food webs and trophic interactions. In the final chapter, anthropogenic influences on the river ecosystem are reviewed and various natural resource management strategies suggested.

46236 **(UCRL—15915) Hydrogeologic investigation, Lawrence Livermore National Laboratory Site 300, Pit 6.** (Brown and Caldwell, Pleasant Hill, CA (USA); Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87014243.

A hydrogeologic investigation was conducted at Lawrence Livermore National Laboratory (LLNL) Site 300, Pit 6 to define the hydrogeologic conditions in the shallow aquifer system beneath the Pit 6 inactive landfill and to assess the adequacy of the groundwater monitoring network at the site. Results of the aquifer tests indicate that impermeable claystone strata present beneath the site on the south side of the Carnegie Fault act as a barrier to groundwater flow through the bedrock strata. However, the alluvium overlying the bedrock does provide an avenue for groundwater flow downgradient beneath the site. North of the Carnegie Fault, groundwater is present primarily in the fractured sandstone bedrock. South of the fault, groundwater flow occurs primarily in the alluvial deposits that overly the impermeable claystone bedrock. The direction of groundwater movement beneath the site is toward the south and southeast at a gradient of about 0.011 to 0.024 feet per foot. Laboratory analyses of groundwater samples collected during this investigation did not detect the presence of any chemical constituents that might be present in the groundwater if wastes buried in the Pit 6 landfill were leaking downward into the shallow aquifer system. These analyses, along with those collected during previous investigations, indicate that groundwater quality in the shallow aquifer system has not been adversely affected by the materials buried in the disposal trenches at the site. Continued groundwater monitoring in the vicinity of Pit 6 should be conducted to detect potential leakage from the disposal trenches.

5206 Regulations

REFER ALSO TO CITATION(S) 45539, 46209, 46211

46237 **(PB—87-188389/XAB) Superfund Record of Decision (EPA Region 1): Tinkham Garage, Londonderry, New Hampshire, September 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1986. 121p. (EPA/ROD/R—01-86/016). NTIS, PC A06/MF A01.

The Tinkham Garage site encompasses 375 acres of residential and undeveloped land in Londonderry, NH. Between 1978 and 1979, waste-disposal activities behind Tinkham garage included the direct surface dumping of liquids and sludge from tank truck washings. In April 1978 citizen complaints of foram and odors in a small unnamed brook resulted in a site cleanup and the excavation of a diversion trench to direct surface runoff. The RI, completed in January 1986, documented contamination from volatile and extractable organic compounds associated with ground water in overburden and bedrock aquifers, surface water, and in soil. The primary contaminants of concern include: VOCs, organic sludges, and metals.

46238 **(PB—87-190054/XAB) Superfund enforcement decision document (EPA Region 5): Burlington Northern (BN), Brainerd, Minnesota, June 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 4 Jun 1986. 39p. (EPA/ROD/R—05-86/031). NTIS, PC A03/MF A01.

The Burlington Northern (BN) site is located in both the City of Baxter and the City of Brainerd, Minnesota. During the 1950s, BN began mixing creosote, a preserver, with Number 5 fuel oil in a 1:1 ratio and later changed to creosote and coal tar which is presently being used in a 70:30 ratio. Wastewater generated from the wood-treating process was sent to two shallow, unlined surface impoundments for disposal. The discharge of wastewater to the disposal ponds generated a sludge that contaminated both the underlying soils and ground water. Ground-water contamination is restricted to a relatively small area downgradient from the site. The primary contaminants of concern include: PAHs, heterocycles, and phenols. Remedial action is proposed and detailed in the report.

53 Social And Economic Studies

REFER ALSO TO CITATION(S) 44976, 45116, 45537

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 45231, 45232, 45862, 45873, 46249, 46266, 46278, 46279, 46296

46239 **(DOE/EV/02725—12) Repair of DNA treated with λ-irradiation and chemical carcinogens: Progress report, 1983-1987.** Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry). Aug 1987. Contract AC02-76EV02725. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013895.

Studies on the in vitro enzymatic mechanisms of DNA repair of chromatin structures are described. In addition new studies on signal transduction in cancer and in carcinogenesis are em-

phasized. We are using molecular biological approaches to three model systems, which we are developing. The first involves signal transduction controlling sis gene (platelet derived growth factor-β) mRNA levels in human glioblastoma cells. The second involves signal transduction in the activation of a long terminal repeat. The third involves an experiment designed to detect a tranposition event in a human cell. This progress report will summarize work on DNA repair of chromatin and then detail our progress in developing the three model systems. 59 refs., 14 figs., 7 tabs.

46240 (GSF—7/86, pp 61) **Heavy metal binding to proteins extracted from rats.** Tykva, R.; Vortruba, J.; Rambeck, W.A.; Kollmer, W.E. (Ceskoslovenska Akademie Ved, Prague. Ustav Organicke Chemie a Biochemie; Muenchen Univ., Germany, F.R. Inst. fuer Physiologie, Physiologische Chemie und Ernaehrungsphysiologie; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Abt. fuer Nuklearbiologie). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87780175. (CONF-8604325—Absts.).

From 4. international workshop on trace element analytical chemistry in medicine and biology; Neuherberg, F.R. Germany (21 Apr 1986).

46241 **Effect of cross linkers on the bacteriorhodopsin photocycle.** Packer, L.; Hrabeta, E.; Robinson, A.E.; Abdulaev, N.G.; Kiselev, A.V.; Taneva, S.G.; Toth-Boconadi, R.; Keszthelyi, L. (Lawrence Berkeley Lab., CA). *Biochemical and Biophysical Research Communications;* **145**: No. 3, 1164-1170(30 Jun 1987).

A general behavior of bacteriorhodopsin in purple membranes from Halobacterium halobium has been observed upon modification resulting in cross-linking of carboxyl and lysine groups. The rise of the M-intermediate contained two components with approximately 50-50% intensity; its decay showed three components with approximately 25-50-25% intensity respectively in a pH range of 5-9. The significance of these remarkably similar data with respect to the proton translocation mechanism in bacteriorhodopsin is that chemical modification allows us to conclude that disturbing parts of the hypothetical proton conducting chain does not inhibit proton translocation.

46242 **Localization of an EGF receptor in purified chromosomes from A431 and lymphoblast cells.** Lin, P.H.; Selinfreund, R.; Albright, K.; Luedemann, M.; Wharton, W. (Los Alamos National Lab., NM). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1996(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

Condensed chromosomes from mitotic cells of A431 and lymphoblast GM131 cells were purified by a flow cytometric sorting and collected directly onto nitrocellulose discs. The blots containing purified chromosomes from A431 cells were then hybridized against iodinated protein ligands. Positive autoradiographic signals were obtained from ^{125}I-epidermal growth factor (EGF), ^{125}I-calmodulin(CAM)-IgG and ^{125}I-#528 monoclonal IgG against EGF receptor, but not from ^{125}I-CAM. Binding of ^{125}I-EGF to the purified chromosomes on the nitrocellulose was specific and reversible upon the addition of excess unlabeled EGF to the hybridization solutions. Blots containing the purified chromosomes of lymphoblast cells gave positive signals for ^{125}I-CAM-IgG, while ^{125}I-CAM signals were not detected. Control experiments showed no detectable contamination from A431 membrane EGF receptor in the purified chromosomal fraction, as demonstrated by the absence of EGF receptor autophosphorylation and the absence of a ^{125}I-EGF hybridization signal in the supernatant solution of the purified chromosomal preparation.

46243 **Cloning of human epidermal growth factor as a bacterial secretory protein, its properties and mutagenesis.** Engler, D.A.; Matsunami, R.K.; Campion, S.R.; Foote, R.S.; Mural, R.J.; Larimer, F.W.; Stevens, A.; Niyogi, S.K. (Oak Ridge National Lab., TN). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1996(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

A chimeric gene, containing the DNA coding for the human epidermal growth factor (EGF) and that for the signal peptide of E. coli alkaline phosphatase, was constructed by the annealing and subsequent ligation of appropriate DNA oligonucleotides synthesized in an automated DNA synthesizer. The gene was then cloned into a bacterial plasmid under the transcriptional control of the E. coli trp-lac (tac) promoter, and then transformed into E. coli. Following induction with isopropylthiogalactoside, the secretion of EGF into the E. coli periplasmic space and some into the growth medium was confirmed by its specific binding to the EGF receptor and stimulation of the EGF receptor tyrosine kinase activity. The size and physicochemical properties of the purified protein mimicked those of authentic human EGF. Studies of structure/function relationships by specific alterations of targeted amino acid residues in the EGF molecule have been initiated by utilizing site-directed mutagenesis.

46244 **Michaelis constants of non-chromogenic substrates may be determined using chromogenic substrates.** Blake, D.A.; Vassall, R.F.; Blake, R.C. II. (Meharry Medical College, Nashville, TN). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1973(1 May 1987). (CONF-870644—). Contract FG05-85ER13339.

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

The object of these experiments was to demonstrate a means of determining the Michaelis constants (Km and Vmax) of a non-chromogenic substrate in a three-part experimental system containing a non-chromogenic substrate, the corresponding enzyme, and an appropriate chromogenic substrate. Two experimental systems were examined, one in which the enzyme activity was subject to product inhibition (alkaline phosphatase) and one in which the activity was not (β-lactamase). In both systems, the initial experimental goal was to quantify the area defined by the entire kinetic trace (absorbance versus time) obtained with the chromogenic substrate in the absence or presence of the non-chromogenic substrate. The difference between these two areas was directly proportional to the concentration of the non-chromogenic substrate and inversely proportional to the Vmax of the non-chromogenic substrate. The value of Vmax thus obtained could then be used with the appropriate integrated Michaelis-Menten rate equation to extract the value of the Km for the non-chromogenic substrate. This method yielded values of kinetic constants that were in good agreement with those obtained directly and/or those available from the literature. It is anticipated that this method may be extended to enzymes with more complicated kinetic mechanisms.

46245 **Fe/sup II/-EDTA-oligodeoxyribunucleoside methylphosphonates (MATAGEN): stability and sequence-specific cleavage of nucleic acids.** Lin, S.B.; Blake, K.; Miller, P.; Ts'o, P. (Johns Hopkins Univ., Baltimore, MD). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1970(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

MATAGEN (Masking Tape for Gene expression) successfully inhibits mRNA expression in mammalian cells. Fe/sup II/-EDTA-MATAGEN and dithiothreitol (DTT), generates hydroxyl radicals to degrade target nucleic acid. d-EDTA x EDA x pAp (A)7 (I), d-EDTA-EDA-pApTA8TC (II) (EDTA linked via ethylenediamine (EDA) to the 5' terminus) and d-ApTA8TC/sup ae.edta/ (III) were prepared. These EDTA-MATAGENS autodegrade in the presence of Fe/sup II/ and DTT; however, MATAGEN backbones remain intact. Autocleavage of I and II takes place at EDA linkage, yielding a single product and is complete in 2 hrs. Whereas, 30% of (III) is modified yielding various products. d-ATG$_2$CTGACTA$_2$T$_8$AT$_3$ATGCAGAG$_3$C$_2$ (SV, a strand of SV-40 replication origin), poly T, oligo T$_{20}$ and poly rU were used as targets for (I), (II) or (III). (I), (II) and (III) (5μM) sequence-specifically cleave SV (50 nM) to the extent of 3%, 8% and 23% respectively at 25°C in 50 mM Tris-HCl pH 7.6. Increased cleavage by (III) may be due to the proximity of the EDTA to the backbone of SV in the duplex as indicated by a higher initial cleavage rate. (I)

cleaves poly T (100%) and oligo T_{20}(40%) presumably due to cooperative binding in 2T:1A triple helix formation, whereas poly rU is degraded less than 10%. EDTA, FE/sup II/ and DTT do not cleave these targets. Thus, EDTA-MATAGENS may be useful as sequence-specific inhibitors of nucleic acid function in living cells.

46246 **Stable reaction products of 3-methyl cytidine with chloroacetaldehyde and acetaldehyde.** Fraenkel-Conrat, H.; Spengler, S.J. (Lawrence Berkeley Lab., CA). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1970(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

Vinyl chloride is an important human carcinogen which is metabolized to the very labile intermediate chloroethylene oxide (CEO) and to chloroacetaldehyde (CAA) which is stable. CAA reacts with cytidine and adenosine to give the fluorescent etheno products, 3,N^4-etheno C and 1,N^6-etheno A. These compounds have not been detected unequivocally in double-stranded DNA in vivo, presumably due to the unavailability of the endo nitrogens necessary for cyclization. To simulate this situation, they have used 3-methyl cytidine as a model. This reacts with CAA at physiological conditions to form small amounts of several labile products. One of these, 30% of reaction, can be stabilized by reduction with sodium cyanoborohydride to a Schiff's type base. An analogous result was obtained by Sattsangi et al. with adenosine and acetaldehyde to yield N^6-ethyl A. However, when 3-methyl cytidine was treated with acetaldehyde, a semistable addition product was obtained with and without SCBH treatment. The mechanism of this reaction and characterization of these N^4-substituted and other nucleoside-aldehyde products will be reported.

46247 **Site-directed mutagenesis of lysine-329 of ribulose bisphosphate carboxylase/oxygenase from Rhodospirillum rubrum.** Soper, T.S.; Larimer, F.W.; Mural, R.J.; Machanoff, R.; Foote, R.S.; Lee, E.H.; Hartman, F.C. (Oak Ridge National Lab., TN). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1976(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

A variety of data suggest that Lys-329 of the title enzyme serves a catalytic function. To test this postulate, Lys-329 has been replaced with Gly, Ala, Ser, Cys, Arg, or Glu by a technique of site-directed mutagenesis that utilizes a suitably gapped plasmid carrying the target gene. The mutant proteins were produced in E. coli JM107 and purified to near homogeneity by immunoaffinity chromatography; they were shown to be dimers, like the wild-type enzyme, by gel electrophoresis. Hence, these amino acid substitutions are compatible with proper folding and association of subunits. The purified mutant proteins do not exhibit detectable enzyme activity nor do they form a stable quaternary complex with Mg^{2+}, CO_2, and a transition-state analog as observed for wild-type enzyme. However, based on ligand-selective elution of the mutant proteins from an affinity matrix (green A agarose) they do retain the ability to bind substrate analogs. These results support an absolute essentiality of Lys-329; its precise function may be illuminated by further characterization of the mutant proteins.

46248 **Restoration of enzyme activity to the Cys-329 mutant of ribulose biphosphate carboxylase/oxygenase by aminoethylation.** Smith, H.B.; Hartman, F.C. (Oak Ridge National Lab., TN). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1976(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

To examine the function of active-site Lys-329 of Rhodospirillum rubrum ribulose bisphosphate carboxylase/oxygenase, the residue has been replaced with other amino acids by site-directed mutagenesis. Although all substitutions results in abolishment of catalytic activity, the Cys-329 mutant provides an opportunity for determining the consequence of a subtle change in the active-site microenvironment - replacement of a lysyl γ-methylene group by a sulfur atom. Treatment of the catalytically inactive mutant protein with bromoethylamine results in 25% restoration of carboxylase activity, presumably reflecting selective aminoethylation of Cys-329. The K/sub m/ values displayed by the novel carboxylase for both CO_2 and ribulose bisphosphate are similar to those of the wild-type enzyme. Like the latter, the aminoethylated protein forms a stable quaternary complex with a transition-state analog, CO_2, and Mg^{2+}. Preliminary assays indicate the ratio of carboxylase/oxygenase activity is unperturbed by the tailored structural change of the catalytic site.

5503 Cytology

46249 **(DOE/EV/03280—T5) [Differentiation and carcinogenesis: An integrated multilevel study of mechanisms from molecules to man].** Ts'o, P.O.P. (Johns Hopkins Univ., Baltimore, MD (USA). School of Hygiene and Public Health). [1987]. Contract AC02-76EV03280. 128p. NTIS MF A01; 2; GPO Dep. File Number DE87008950.

Because of the establishment of an extrapolation between in vivo and in vitro Syrian hamster systems, the interrelationship among differentiation, aging, and cancer can now be investigated experimentally. We have realized the importance of investigating the properties of individual cells in a population at the molecular level. We have developed monoclonal antibodies, specific nucleic acid enzymes and specific nucleic acid probes as reagents. The data from individual cell studies are now being analyzed by computer-assisted microphotometry. We have realized the importance of DNA rearrangement, DNA methylation status, and DNA (gene) amplification. We have developed or designed powerful biological and molecular procedures which were previously unavailable, for this investigation. We have developed reagents which can modify gene expression in living cells, and have designed vehicles to introduce foreign genes effectively into living cells. We have now applied powerful nuclear magnetic resonance techniques not only for studies of biological compounds but to study the living systems in a non-invasive manner, particularly in relation to the important question of water structure and activities involved in cell replications.

5504 Genetics

REFER ALSO TO CITATION(S) 45231, 45888, 46306, 46320

46250 **(DOE/ER/60014—01) Evolution of correlated characters in complex genetic systems and at the phenotypic level: Final report for period September 1, 1981 to August 31, 1987.** Lande, R.S.; Wood, A.M. (Chicago Univ., IL (USA)). Aug 1987. Contract AC02-81ER60014. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014125.

Population genetic models were developed to investigate processes involved in the evolution of major chromosomal rearrangements in animals. Cytological and ecological data were used to evaluate the models. Variation in selection coefficients and population structures involving local extinction and recolonization were found to be important factors in chromosomal evolution. Experimental quantitative genetics was used to estimate the genetic component of phenotypic variation in morphological and physiological characters of three species of marine phytoplankton: a diatom, a dinoflagellate and a cyanobacterium. Substantial genetic variance was detected in all characters, including photosynthetic traits, in each of the species, indicating the potential for rapid adaptive evolution in response to environmental change. The interaction of physical and biological factors affecting photosynthesis and primary production in the ocean was investigated by modelling the vertical motion of phytoplankton cells in the upper ocean caused by turbulence and internal waves. The ability of phytoplankton cells to regulate their sinking rate with depth has important and unexpected consequences on their suspension times at different depths. In some situations, internal waves may greatly increase primary production. 6 refs.

5505 Metabolism

REFER ALSO TO CITATION(S) 46305

5506 Medicine

REFER ALSO TO CITATION(S) 46284, 46300, 46710, 46714, 46715, 46716, 46717, 46718, 46719, 46720

46251 (GSI—86-47-Prepr.) Biological effects of heavy ions. Kraft, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1986. 18p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-10622.

Lecture presented to a symposium held on the occasion of the sixth centennial celebration of Heidelberg University, and 80th anniversary of the Czerny Hospital.

The survey presents a few selected examples showing that radiotherapy using heavy ions can contribute to better achievements. Clinical experience has proven that better dose distributions lead to better results. Further research work will have to show whether high LET will bring about a specific advantage for radiotherapies.

46252 (INIS-mf—10904, pp 461) **Alternation of chemotherapy (CT) and radiotherapy (RT) in squamous cell carcinoma of the head and neck (SCC-HN): a phase III study.** Rosso, R.; Merlano, M.; Benassa, M.; Sertoli, M.R.; Bonelli, L.; Margarino, G.; Corvo, L. (National Inst. of Cancer Research, Genova, Italy; Genova Univ., Italy. School of Medicine). 1986. NTIS (US Sales Only), PC A21/MF A01. File Number DE87702300. (CONF-8608169—Vol.1-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

46253 (INIS-mf—10946, pp 46-49) **Pilot study for the introduction of dental exposure normalization technique (DENT) in Israel.** Shleien, B.; Brenner, S.; Hai, J.; Lichter, A.; Orenstein, P.; Ne'eman, E. (Ministry of Health, Tel-Aviv, Israel. Res. Inst. for Environmental Health). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46254 (INIS-mf—10946, pp 50-53) **Detection of an unknown fault in a Cobalt-60 radiotherapy unit during a quality assurance check.** Mandelzweig, Y.; Yudelev, M.; Tatcher, M.; Debre, A. (Rambam Medical Center, Haifa, Israel; Levant X-Ray Ltd., Herzliya, Israel). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46255 (INIS-mf—10949) VIIIth international symposium on nuclear medicine. Abstracts. (Ceskoslovenska Lekarska Spolecnost J.E. Purkyne, Prague). 1986. 81p. (CONF-8606328—Absts.). NTIS (US Sales Only), PC A05/MF A01. File Number DE87702907.

From 8. international symposium on nuclear medicine; Karlovy Vary, Czechoslovakia (2 Jun 1986).

The conference proceedings contain 92 abstracts of submitted papers dealing with various applications of radioisotopes in diagnosis and therapy. The papers were devoted to scintiscanning, radioimmunoassay, tomography, the applications of nuclear magnetic resonance and electron microscopy in different branches - oncology, cardiology, neurology, histology, gynecology, internal medicine, etc. (M.D.).

46256 (LBL—23505) Projection-space iterative interpolation for limited-angle tomography in parallel- and fan-beam geometry: Part 1. Heiskanen, K.; Wang, Jong-Jin; Perez-Mendex, V. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013965.

In computed tomography one reconstructs the image of an object from its projections. The limited-angle tomography problem arises when the number of projections available is too small, or the projections are not obtained from all angles around the object, evenly enough distributed. Such is the case, when the object moves while the projections are measured, for example CT - scanning the beating heart. A new algorithm, the projection-space iterative reconstruction-reprojection (PSIRR), estimates the missing projection data from the known data. This method is valid for parallel-beam projections only. In this paper their method is further modified and discussed. A similar iterative interpolation algorithm is derived for estimating missing projection data in fan-beam geometry. 10 refs., 5 figs.

46257 (LUNBDS-NBZF—1020-1-54(1986)) Radioimmunoassay of 1-Deamino-8-D-Arginine Vasopressin and related peptides with special condsideration to their gastrointestinal absorption. Lundin, S. (Lund Univ. (Sweden). Dept. of Zoophysiology). 1986. 46p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752419.

A sensitive and specific radioimminoassay for 1-deamino-8-D-Arginine vasopressin (DDAVP) was developed. Measurements of the analogue in extraced and non-extracted plasma yielded indentical results, the sensitivity was reduced with non-extracted samples. The assay was validated by correlating DDAVP blood levels to a biologic response (antidiuretic). Dilutions of plasma extracts containing DDAVP were parallel with the standard curve. Fractionations of extracted plasma DDAVP samples on HPLC revealed that immunoreactivity eluted as standard DDAVP. Prolonged infusion of DDAVP in rats did not alter pituitary secretion of oxytocin and vasopressin and urine osmolatity and volume changes were modest. DDAVP was absorbed from the gastrointestinal tract of humans, rats, rabbits and dogs in quantities sufficient to induce a biological response. Peak plasma concentrations were reached between 30-90 min after peptide administration. By the use of an in vitro model, the everted rat intestine, the transmucosal passage of a number of vasopressin analogues were tested. There was no clear-cut correlation between hydrophobicity and intestinal transport rates. Metabolic inhibitors and N/sub 2/ did not decrease DDAVP transport. No transport maximum could be demonstrated over a 10/sup 4/ fold concentration range. The distribution volume of /sup 3/H-polyethyleneglycol was greater than that of DDAVP in mucosal flakes. There was a close correlation between immunoassayable DDAVP levels and those found after HPLC analyses. It is proposed that absorption occurs mainly by passive diffusion. The bioavailability of perorally ingested DDAVP in humans was about 1 percent. Minor amounts were excreted in urine. With 108 refs.

46258 (PEL—287) Radioactive isotopes and radiation in South Africa: a bibliographic review. Basson, J.K. (ed.). (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Dec 1985. 108p. (In English and Afrikaans). NTIS (US Sales Only), PC A06/MF A01. File Number DE87703127.

This bibliographic review consists of an introduction and four categories on this subject field, each with its own bibliography.

The development of isotope applications has been a main theme of the erstwhile Atomic Energy Board which organized a national conference in Pretoria in 1963 'to take stock of the work done in the country so far'. Radioactive isotopes and radiation have achieved widespread use in all fields of medicine, agriculture, science and technology. It was recommended that the AEC publish a review of relevant South African work. This publication therefore consists of listings of available publications by South African-based scientists since the 1963 Conference and is divided into the four categories: radiotherapy, clinical and laboratory medicine, agriculture, and industry, preceded by overviews. The terms of reference were construed not to include stable isotopes and it was accordingly decided to concentrate only on radioisotope applications.

46259 (PEL—287, pp 13E-34) **Research with radioisotopes in clinical and laboratory medicine: a bibliographic review.** Metz, J.; Van der Walt, L.A.; Malan, J.M. (South African Inst. for Medical Research, Johannesburg). Dec 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87703127.

This bibliographic review consists of an introduction and four categories on this subject field, each with its own bibliography.

In Radioactive isotopes and radiation in South Africa: a bibliographic review.

This bibliography is restricted mainly to AEC-supported projects which are considered to amply reflect the widespread use of radioisotopes in clinical and laboratory medicine in South Africa and which describe research with radioisotopes of some direct relevance to diagnostic-clinical or laboratory medicine, or both, but excluding therapy with isotopes. General information is given in this review on oncology, endocrinology, metabolism and nutrition, haematology, neurology, angiocardiology, pulmonology, gastroenterology, gynaecology and obstetrics, nephrology, immunology and transplantation, microbiology and parasitology.

46260 (PEL—287, pp 1E-3A) **Development of radioisotope applications in South Africa.** Basson, J.K. Dec 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87703127.

This bibliographic review consists of an introduction and four categories on this subject field, each with its own bibliography.

In Radioactive isotopes and radiation in South Africa: a bibliographic review.

The first era of radioactive isotopes and radiation since the turn of the century was inevitably restricted to x-rays and radium, with the greatest application in medicine for diagnosis and therapy. In South Africa a second era began when the first artificial radioisotope was imported on 27 July 1948, and the medical practitioners, in particular, were ready to use this new modality also as a tracer. This article gives general information on radiation protection, isotope users, therapy and in vivo and in vitro tests with radioisotopes in South Africa.

46261 (PEL—287, pp 4E-12) **Review of radioisotope use in therapeutic radiology in South Africa.** Anderson, D.J. (National Hospital, Bloemfontein, South Africa). Dec 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87703127.

This bibliographic review consists of an introduction and four categories on this subject field, each with its own bibliography.

In Radioactive isotopes and radiation in South Africa: a bibliographic review.

Since the /sup N/ational Conference on Nuclear Energy: application of isotopes and radiation, Pretoria (1963)/sup ,/ radiotherapy has advanced steadily as an established medical discipline in South Africa. In compiling this bibliography the author has limited the field to publications in radiotherapy by South Africans. General information an photon teletherapy, interstitial and intracavitary radiotherapy, and particle beams is given in this bibliographic review.

5507 Microbiology

REFER ALSO TO CITATION(S) 45198, 45200, 45239

46262 (IFU-B—14-86, pp 213-228) **Microbiological analyses of methanogenic bacteria.** Scheucher, P. (Technische Univ., Graz, Austria. Inst. fuer Biotechnologie, Mikrobiologie und Abfalltechnologie). 1986. (In German). Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung. (CONF-8604352—Summs.).

From Experts' meeting on agricultural uses of biogas; Vienna, Austria (16 Apr 1986).

The optimized formation of methane can essentially contribute to an economic operation of biomass conversion plants. With the help of innovative microbiological methods methanogenic bacteria were analyzed both for the medium they require and for their metabolic features. The data obtained with respect to the growth rate, gas formation rate and generation rate throw light on the starting process of biomass conversion plants. Analyses have given proof of the fact that both the oxygen tolerance and the methanogenic bacteria's ability of outliving periods of famine account for their quasi-omnipresence in nature.

46263 **Vertical spectrophotometry for measuring antibodies to a variety of microbes using a microimmunoenzymatic assay on a flat surface.** De Macario, C.; Jovell, R.J.; Macario, A.J.L.; Stahl, W. (NYSDH, Albany). *Abstracts of the Annual Meeting of the American Society for Microbiology;* No. C161, 338(1983).

A novel micro-immunoenzymatic method was developed based on ELISA principles. It is performed with as little as 5 μl of each reagent on a flat, circular area a few mm in diameter. The reaction area is encircled by an extrathin layer of a hydrophobic material avoiding diffusion of reagents. These stay drop-shaped which allows OD readings directly in the drop of enzyme substrate added in the last step of the assay, using a small, low-cost, vertical beam spectrophotometer. Many reaction areas (18 or 30, 3 or 2 mm in diameter, respectively) can be printed on a standard histopathology glass slide. One operator can assay 100 samples per run in 2 hr, using 6 slides precoated with antigen. This slide micro-immunoenzymatic assay (micro-SIA) probed useful for measuring antibodies to a variety of eu- and archae-bacteria (cocci, rods, spirilla, sarcina), fungi, protozoa and viruses, in sera from several animal species and in medium from cultures of antibody-forming cells. Other important advantages of micro-SIA are its reproducibility, negligible background and simplicity. It can be performed in unsophisticated laboratories and it can be used for field studies, since it is amenable to a semi-quantitative evaluation by eye readings.

5508 Morphology

REFER ALSO TO CITATION(S) 46249

5509 Pathology

46264 **(AD-A—181336/9/XAB) Synthesis of radiolabeled mycotoxins. Annual report, 1 December 1985-30 November 1986.** Kraus, G.A. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Chemistry). 1 Feb 1987. 4p. NTIS, PC A02/MF A01.

The synthesis of labeled trichothecenes by degradation of diaceotxy scirpenol (DAS) is the subject of this report. The DAS was acetylated and deoxygenated to provide a diene which was selectively oxidized, deuterated, and epoxidized. This enone has been reduced. The remaining steps, separation and acetate removal, are in progress.

5510 Physiological Systems

46265 **(AD-A—181694/1/XAB) Annotated bibliography of psychomotor testing. Technical report.** Ervin, C. (Anthropology Research Project, Inc., Yellow Springs, OH (USA)). Mar 1987. 37p. NTIS, PC A03/MF A01.

An annotated bibliography of 67 publications in the field of psychomotor testing has been prepared. The collection includes technical reports, journal articles, presented at scientific meetings, books and conference proceedings. The publications were assembled as preliminary work in the development of a dexterity test battery designed to measure the effects of chemical-defense-treatment drugs.

46266 **(AD-A—181867/3/XAB) Incorporation of haemoglobin haem into the rat hepatic haemoproteins tryptophan pyrrolase and cytochrome P-450.** Wyman, J.F.; Gollan, J.L.; Settle, W.; Farrell, G.C.; Correia, M.A. (Naval Medical Research Inst., Bethesda, MD (USA)). 1986. 11p. (NMRI—86-90). NTIS, PC A02/MF A01.

Pub. in Biochemical Jnl., Vol. 238, 837-846(1986).

After its administration to intact rats, haemoglobin haem was incorporated into hepatic tryptophan pyrrolase as shown by the marked increase in functional constitution of this enzyme. Incorporation of haemoglobin haem into cytochrome P-450 was demonstrated in intact rats and in the isolated rat liver perfused with haemoglogin-free medium. In both systems, haemoglobin haem restored cytochrome P-450 content and its dependent mixed-function-oxidase activity after substrate-induced destruction of the cytochrome P-450 haem moiety. Further confirmation that heamoglobin haem could be incorporated prosthetically into cytochrome P-450 was achieved by administration of (tritium) haemoglobin to rats and subsequent isolation and characterization of radiolabelled substrate-alkylated products of cytochrome P-450 haem. Findings indicate that, although hepatic uptake of parenteral haemoglobin is slower than that of haem, it appears to serve as an effective haem donor to the intrahepatic free haem pool. Thus parenteral haemoglobin may warrant consideration as a therapeutic alternative to haem in the acute hepatic porphyrias.

46267 (GSF—7/86, pp 29) **Platelet and erythrocyte kinetics studied with selenium-74.** Kiem, J.; Koslowski, G.; Weese, H.; Feinendegen, L.E. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R. Inst. fuer Medizin). 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE87780175. (CONF-8604325—Absts.).

From 4. international workshop on trace element analytical chemistry in medicine and biology; Neuherberg, F.R. Germany (21 Apr 1986).

5520 Public Health

REFER ALSO TO CITATION(S) 44986, 45006, 45542, 45543, 46172, 46173, 46174, 46175, 46176, 46721

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 45234, 45235, 45236, 45671, 46258

46268 **(ISH—102) Treatment of spices with ionizing radiation - chemical, sensory, microbiological and toxicological aspects. Pt. 3.** Schuettler, C.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Oct 1986. 69p. (In German). Bundesgesundheitsamt, Neuherberg, Germany, F.R. Inst. fuer Strahlenhygiene.

In the present third part of a study of the relevant literature the results of tests on 34 different radiation treated spices were evaluated. Moreover, the present part contains a summary of all analyses and results, described in the previous parts, in chemical and toxicological changes of spices caused by irradiation. This summary contains results of 55 different spices.

46269 (PEL—287, pp 35E-59) **Review of nuclear techniques in South African agricultural research: 1963-1984.** Marais, P.G.; Kotze, W.A.G.; Joubert, M.E.; Huismans, H.; Brodrick, H.T. (Fruit and Fruit Technology Research Inst., Stellenbosch, South Africa; Veterinary Research Inst., Onderstepoort, South Africa; Nuclear Development Corp. of South Africa, Pty. Ltd., Pelindaba, Pretoria). Dec 1985. NTIS (US Sales Only), PC A06/MF A01. File Number DE87703127.

This bibliographic review consists of an introduction and four categories on this subject field, each with its own bibliography.

In Radioactive isotopes and radiation in South Africa: a bibliographic review.

The use of nuclear techniques in agriculture research in the RSA was reviewed at a National Conference on Nuclear Energy in 1963. Since then, 573 publications on the use of nuclear techniques in agriculture have appeared, which can be classified as follows: zoology; botany; food irradiation; soil and plant relations; soil moisture and ground water studies; and other radiation and tracer applications. A survey of literature on the use of radioactive isotopes in agriculture published between 1973 and 1980, including South African publications, was compiled by the Atomic Energy Board in 1980 but did not include any review of the scientific material.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 45541

46270 **(AD-A—181781/6/XAB) Novel interaction of diethyldithiocarbamate with the glutathione/glutathione peroxidase system.** Kumar, K.S.; Sancho, A.M.; Weiss, J.F. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Aug 1986. 6p. (AFRRI-SR—86-42). NTIS, PC A02/MF A01.

Pub. in International Jnl. Radiation Oncology, Biology, Physics, Vol. 12, No. 8, 1463-1467(Aug 1986).

Diethyldithiocarbamate (DDC) exhibits a variety of pharmacologic activities, including both radioprotective and sensitizing properties. Since the glutathione/glutathione peroxidase system may be a significant factor in determining radiation sensitivity, the potential mechanisms of action of DDC in relation to this system were examined in vitro. The interaction of DDC with reduced glutathione (GSH) was tested using a simple system based on the reduction of cytochrome c. When DDC(0.005 mM) was incubated with GSH(0.5mM), the reduction of cytochrome c was eightfold greater than that expected from an additive effect of DDC and GSH could be replaced by oxidized glutathione and glutathione reductase. Cytochrome c reduced by DDC was oxidized by mitochondria. The interaction of DDC with both the hexosemonophosphate shunt pathway and the mitochondrial respiratory chain suggests the possibility of linking these two pathways through DDC. Oxidation of DDC. Oxidation of DDC by peroxide and reversal by GSH indicated that the drug can engage in a cyclic reaction with peroxide and GSH. This was confirmed when DDC was used in the assay system for glutathione peroxidase (GSHPx) without GSHPx DDC at a concentration of 0.25 mM was more active than 0.01 unit of pure GSHPx in eliminating peroxide, and much more active than the other sulfhydryl compounds tested. These studies indicate that DDC can supplement GSHPx activity or substitute for it in detoxifying peroxides, and suggests a unique role in the chemical modification of radiation sensitivity.

46271 **(AD-A—181788/1/XAB) Urinary excretion of cyclic nucleotides, creatinine prostaglandin E2 and thromboxane B2 from mice exposed to whole-body irradiation from an enhanced neutron field.** Steel, L.K.; Rafferty, M.A.; Wolfe, W.W.; Egan, J.E.; Kennedy, D.A. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 22p. (AFRRI-SR—86-49). NTIS, PC A02/MF A01.

Pub. in International Jnl. of Radiation Biology, Vol. 50, No. 4, 695-715(1986).

Urine volume and excretion of cyclic AMP, cyclic GMP, prostaglandin E2 (PGE2), thromboxane B2 (TxB2) and creatinine were evaluated as potential indicators of radiation damage in mice given 2-5 Gy to the whole body from an enhanced neutron field. In general, urinary cyclic AMP, cyclic GMP, creatinine and urine volumes were positively correlated across time postexposure, for each radiation dose. TxB2 levels positively correlated with urine volume and cyclic AMP excretion only in animals given 2.0Gy. None of these parameters suggests their use as a prognostic indicator of the extent of radiation damage. Urinary excretion of PGE2 was negatively correlated with other urinary parameters. Biphasic increases in urinary PGE2 were also observed. The initial transient elevation 2-3 days postexposure was not correlated with the dose (2-5 Gy). The second elevation of PGE2 excretion occurred at 6-10 days. The magnitude of the latter increase suggests that urinary PGE2 excretion may be a useful indicator of whole-body or kidney exposure to neutron fields.

46272 **(AD-A—181790/7/XAB) Development of a model system to study leukotriene-induced modification of radiation sensitivity in mammalian cells.** Walden, T.L.; Holahan, E.V.; Catravas, G.N. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 5p. (AFRRI-SR—86-51). NTIS, PC A02/MF A01.

Pub. in Prog. Lipid Res., Vol. 25, 587-590(1986).

Leukotrienes (LT) are an important class of biological mediators, for which no information exists concerning their synthesis following a radiation insult, or on their ability to modify cellular response to a subsequent radiation exposure. LT are derived from arachidonic acid, as are prostaglandins, although by a separate enzyme system. Prostaglandins are able to modify radiosensitivity of mammalian cells in vivo and in vitro. In addition, the cytoprotective effect induced by prostaglandins may have significance in cancer therapy since certain breast cancers which secrete elevated levels of prostaglandins are more resistant to therapy than similar tumors without the prostaglandin elevation. The objective of this study was to define a model system in which the metabolic fate of the LT could be monitored, and the effort of LT on the ionizing radiation sensitivity of mammalian cells in vitro could also be characterized.

46273 (AD-A—181791/5/XAB) Stochastic models for cells exposed to ionizing radiation. Yang, G.L.; Swenberg, C.E. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 6p. (AFRRI-SR—86-52). NTIS, PC A02/MF A01.

Pub. in Modelling of Biomedical Systems, 85-89(1986).

The stochastic model for survivability of cells subjected to ionizing radiation initially formulated by Neyman and Puri is modified to include both the plating time to cell proliferation and dose saturation of potential lethal damage. This necessitates a reformulation of the cell survival and mutation probability. Based on the new model the authors derive the the probability of occurrence for several experimental end points. The predictions of the model compare favorably to data for diploid yeast cells irradiated with 30-MeV electrons.

46274 (AD-A—181847/5/XAB) Rapid communication neutron-induced free radicals in oriented DNA. Arroyo, C.M.; Carmichael, A.J.; Swenberg, C.E.; Myers, L.S. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 7p. (AFRRI-SR—86-34). NTIS, PC A02/MF A01.

Pub. in International Jnl. Radiation Biology, Vol. 50, No. 5, 789-793(1986).

Electron spin resonance (e.s.r.) of solid-state-oriented deoxyribonucleic acid (DNA) irradiated with neutrons is of interest because it offers, at low temperatures, an opportunity to study structural features of the free radicals formed in oriented macromolecular samples. In addition, it provides further information about the mechanism of radiation damage in living systems. In previous studies, e.s.r. spectroscopy has been applied to observe the effects of gamma and uv radiation on oriented DNA fibres. With uv and gamma radiation, a mixture of anionic free radicals on thymine and cationic free radicals on guanine has been reported. The e.s.r. spectra obtained in those studies depended on the orientation (parallel or perpendicular) of the fibres in the magnetic field. However, when the full uv spectrum is used to irradiate the oriented DNA fibres, an eight-line e.s.r. spectrum is observed. This additional e.s.r. spectrum corresponds to the hydrogen addition radical on thymine (TH). The e.s.r. spectrum of TH is nearly isotropic.

46275 (AD-A—181849/1/XAB) Dose-dependent radiation-induced hypotension in the canine. Cockerham, L.G.; Hampton, J.D.; Doyle, T.F. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). 1986. 6p. (AFRRI-SR—86-36). NTIS, PC A02/MF A01.

Pub. in Life Sciences, Vol. 39, No. 17, 1543-1547(1986).

Radiation-induced early transient incapacitation (ETI) is often accompanied by severe systemic hypotension. However, postradiation hypotension does not occur with equal frequency in all species and is not reported with consistency in the canine. In an attempt to clarify the differences in reported canine post-radiation blood pressures, canine systemic blood pressures were determined both before and after exposure to gamma radiation of either 80 or 100 Gy. Data obtained from six sham-radiated beagles and 12 radiated beagles indicated that 100-Gy, whole-body, gamma radiation produced a decrease in systemic mean blood pressure while 80-Gy, whole-body, gamma radiation did not. Analysis of this data could be consistent with a quantal response to a gamma radiation dose between 80 Gy and 100 Gy.

46276 (AD-A—181851/7/XAB) Hepatobiliary kinetics after whole-body irradiation. Durakovic, A. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Sep 1986. 4p. (AFRRI-SR—86-38). NTIS, PC A02/MF A01.

Pub. in Military Medicine, Vol. 151, No. 9, 487-489(Sep 1986).

The purpose of this investigation was to study hepatobiliary kinetics after whole-body gamma irradiation. Two groups of nine male beagle dogs were irradiated with a single whole body dose of 4- and 8-Gy cobalt-60 photons. Each animal was injected with 2 mCi Tc-99m DISIDA and scintigraphic studies were obtained with a gamma camera with a parallel hole multipurpose collimator. The parameters studied included: peak activity of the liver and gall bladder and gall bladder and intestinal visualization from the time of Tc-99m DISIDA administration. Total and indirect bilirubin, LDH, SGOT, and SGPT determined as baseline studies before irradiation and at different time intervals after irradiation were not changed in irradiated animals. Whole body Co-60 irradiation with 4 and 8 Gy produced no significant changes in the Tc-99m DISIDA visualization of the gall bladder or in the peak activity in the gall bladder or the liver 1 and 7 days after irradiation. Intestinal visualization occurred significantly earlier in 8 Gy Co-60 irradiated animals on both day 1 and day 7 post irradiation, compared to baseline values where it was never observed before 195.0 minutes. Gall bladder emptying is significantly accelerated after 8 Gy but not after 4-Gy Co-60 gamma irradiation. These observations suggest that gamma irradiation stimulates gall bladder contractility without modifying intrahepatic biliary kinetics.

46277 (DOE/ER/60390—T1) Electron transport calculations with biomedical and environmental applications: [Progress report, FY 1987]. (National Bureau of Standards, Washington, DC (USA)). 1987. Contract AI05-86ER60390. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013666.

This project investigated radiation interactions with matter and radiation transport in bulk media, to generate basic radiological physics information. Applications include biomedical radiation dosimetry, the assessment of radiation hazards in nuclear technology, and modeling of biological radiation action. This work included the development of transport-theoretic methods, the compilation and critical evaluation of the underlying single-scattering cross sections, and the application of the transport methods to radiological physics problems. 7 refs.

46278 (DOE/EV/03571—24) Biological effects of DNA repair, including mutagenesis: Final report for period January 1, 1984-May 31, 1987. Hutchinson, F. (Yale Univ., New Haven, CT (USA). Dept. of Molecular Biophysics and Biochemistry). Jul 1987. Contract AC02-76EV03571. 12p. (COO—3571-24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013690.

Changes in base sequence at mutations in the cI repressor gene in lambda phage irradiated with gamma rays were assayed in E. coli host in which the SOS response had been fully induced. 10 refs., 1 fig.

46279 (DOE/EV/70032—T3) [Studies on the repair of damaged DNA in bacteriophage, bacterial and mammalian systems]: Final report. Friedberg, E.C. (Stanford Univ., CA (USA). Dept. of Pathology). Aug 1987. Contract AT03-76EV70032. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014165.

This study sought to exploit the use of uv radiation as a source of genomic damage. We explored the molecular mechanism of the repair of DNA damage at a number of different levels of biological organization, by investigating bacteriophage, bacterial, yeast and mammalian cells. Not only have observations obtained in one biological system suggested specific experimental approaches in others, but we have also learned that some biochemical pathways for DNA repair are unique to specific organisms. Our studies are summarized in terms of 4 major areas of research activity that span the past 16 years. 86 refs.

46280 **(IFEU—25) Forest decline, natural and technically generated radioactivity. Expertise on possible relations between effluent radioactive rare gas from nuclear plants and forest decline and regarding the comparability of natural and artificial radioactivity.** Teufel, D. (Institut fuer Energie- und Umweltforschung e.V., Heidelberg (Germany, F.R.)). Jun 1983. 42p. (In German). Institut fuer Energie- und Umweltforschung e.V., Heidelberg, Germany, F.R.

The question investigated is whether the radioactive rare gases emanating from nuclear plants are causative or participate in the triggering of forest disease. For one thing, a chemical reaction could be responsible for such an effect exerted by these artificial radioactive effluents. However, a calculation shows the concentration of radionuclides, respectively, in this case, their decomposition products, to be by many orders of magnitude smaller than other constituents in air; so a chemical reaction of this kind may be excluded. For the other part, rare gases might contribute to forest damage by their radioactive decomposition and late physical, chemical, and biological effects. In this connection, a detailed analysis is made of the comparability of natural radioactivity with radioactivity generated by nuclear plants. A possible contribution towards the total stress situation of forests (chemical air pollution, natural radioactivity, artificially produced radioactive rare gases, weather conditions and conditions arising from forest management and the like) would amount to a proportion smaller than 1/1000 considering natural radioactivity as a possible stress factor only.

46281 **(INIS-mf—10699) Radiation exposure from glazed, uranium-bearing pottery or porcelain ware.** Heiland, C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1980. 62p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10624.

An uranium-bearing tea set is taken as the example to explain the radiation exposure of the population through external or internal irradiation as a consequence of daily use of household pottery. The experiments reported determine the amount of uranium dissolved in the tea, or tea plus lemon juice, by various methods. The lemon juice is shown to increase the uranium leaching rate. Dose measurements at the pottery surfaces allow the calculation of external radiation doses to lips or hands. The uranium content of the tea set used for the study is high, and the resulting radiation doses exceed the limits set by the Radiation Protection Ordinance.

46282 (INIS-mf—10916, pp 843) **Combined effect of hyperthermia and X-irradiation on survival and protein pattern of P388 tumor bearing mice.** Perlaky, L.; Fonagy, A.; Hidvegi, E.J. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest, Hungary). 1986. NTIS (US Sales Only), PC A99/MF A01. File Number DE87702596. (CONF-8608169—Vols.2,3-Absts.).

From 14. international cancer congress; Budapest, Hungary (21 Aug 1986).

46283 (INIS-mf—10939, pp 7-9) **Beneficial effects of small-dose ionizing radiations.** Wachsmann, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Inst. fuer Strahlenschutz). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703106.

In Radiation protection 1/87.

46284 (INIS-mf—10939, pp 5-7) **Doctors activities after radiation accidents.** Niklas, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg, Germany, F.R. Inst. fuer Strahlenschutz). 1987. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703106.

In Radiation protection 1/87.

46285 (INIS-mf—10946, pp 43-45) **Increased radioprotection attained by DNA repair enhancement.** Riklis, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46286 (INIS-mf—10946, pp 16-19) **Model of population protection as applied to an urban area for a hypothetical nuclear power plant accident.** Koch, J.; Tadmor, J. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46287 **(INIS-mf—10946) 1987 Annual Meeting. Program and abstracts of lectures.** (Israel Health Physics Society). 1987. vp. (CONF-8704181—). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161.

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

Items within the scope of EDB have been entered individually into the data base. (ACR)

46288 (KURRI-TR—279, pp 1-9) **DNA damage caused by UV- and near UV-irradiation.** Ohnishi, Takeo. (Nara Medical Univ., Kashihara, Japan). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780157. (CONF-8602138—).

From Symposium on fundamental problems in biological damage by radiation; Kumatori, Japan (21 Feb 1986).

Much work with mutants deficient in DNA repair has been performed concerning UV-induced DNA damage under the condition where there is no artificial stimulation. In an attempt to infer the effects of solar wavelengths, the outcome of the work is discussed in terms of cellular radiation sensitivity, unscheduled DNA synthesis, and mutation induction, leading to the conclusion that some DNA damage occurs even by irradiation of the shorter wavelength light (270 - 315 nm) and is repaired by excision repair. It has been thought to date that pyrimidine dimer (PD) plays the most important role in UV-induced DNA damage, followed by (6 - 4) photoproducts. As for DNA damage induced by near UV irradiation, the yield of DNA single-strand breaks and of DNA-protein crosslinking, other than PD, is considered. The DNA-protein crosslinking has proved to be induced by irradiation at any wavelength of UV ranging from 260 to 425 nm. Near UV irradiation causes the inhibition of cell proliferation to take place.

46289 (KURRI-TR—279, pp 10-15) **Ionizing radiation-induced DNA damage. Its detection and relevance to cellular lethality.** Sakai, Kazuo. (Tokyo Univ., Japan. Faculty of Medicine). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780157. (CONF-8602138—).

From Symposium on fundamental problems in biological damage by radiation; Kumatori, Japan (21 Feb 1986).

In an attempt to elucidate the mechanisms by which cells are killed by ionizing radiation, a large number of studies on changes at DNA molecules (DNA damage) have been performed by various techniques. This paper gives an overview of techniques for detecting DNA damage, such as sucrose density sedimentation, alkaline separation or elution technique, enzymatic procedure, chromatography, and the usage of fluorescent pigments. The previous work on DNA damage has focussed on DNA strand breaks including alkali-labile lesions in DNA. As for the cause-effect relationship between DNA damage and cell death, the number of DNA breaks increased under the condition where a radiosensitizer was given in cultured cells; on the contrary, it decreased under the condition where a radioprotector was given. This indicated the relationship between DNA damage and cell death. However, this relationship has become obscure when studied in view of radiosensitivity during cell cycle and in cells themselves, and high-LET radiations. When considering nonreparable or remaining breaks, radiation-induced cell death could be explained. This phenomenon was, however, ruled out in the study with two cell lines with different radiosensitivity. Studies from various points of view, such as DNA damage induction, its repair, its remaining breaks, and the cell cycle, are required for elucidating the relationship between DNA damage and cell death.

46290 (KURRI-TR—279, pp 16-29) **Sublethal damage, potentially lethal damage and lethal damage produced by ionizing radiations.** Utsumi, Hiroshi. (Kyoto Univ., Japan. Faculty of Medicine). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780157. (CONF-8602138—).

From Symposium on fundamental problems in biological damage by radiation; Kumatori, Japan (21 Feb 1986).

It is thought that expression of sublethal damage (SLD) would never occur. SLD produced by the first exposure to ionizing radiations would be completely repaired 12 hr later, and there are no interactive abilities of SLDs that are produced by the first and second exposures. There is some evidence that SLD is a manifestation of lesions in DNA or DNA degradation and that the repair of SLD is the repair of DNA degradation. Potentially lethal damage (PLD) is recognized as cell damage that occurs depending on physical and chemical conditions after irradiation. Two types of PLD, slow-type PLD (s-PLD) and fast- type PLD (f-PLD), were seen when the cells were incubated in growth medium with phosphate-buffered saline after irradiation. Both types of PLD exhibited independent repair processes with individual genes involved in PLD repair. In addition, the repair processes of SLD and PLD have proved to be different. The previous observations have suggested that s-PLD is break at chromosome levels involved in double strand breaks of DNA; and that f-PLD is damage at the DNA-nucleoid matrix membrane. The more recently available data have supported the hypothesis that lethal damage is a manifestation of double strand breaks of DNA, indicating that different genetic mechanisms at G1 and S phases are responsible for the repair of double-strand breaks.

46291 (KURRI-TR—279, pp 30-38) **Mutational specificity of SOS mutagenesis.** Kato, Takeshi. (Osaka Univ., Japan. Faculty of Medicine). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780157. (CONF-8602138—).

From Symposium on fundamental problems in biological damage by radiation; Kumatori, Japan (21 Feb 1986).

In an approach to the isolation of mutants of E. coli unable to produce mutations by ultraviolet light, the author has found new umuC-mutants. Their properties could be explained by "SOS hypothesis of Radman and Witkin", which has now been justified by many investigators. Analysis of the umuC region of E. coli chromosome cloned in pSK 100 has led to the conclusion that two genes, umuD and umuC, having the capacity of mutation induction express in the same mechanism as that of SOS genes, which is known to be inhibited by LexA protein bonding to "SOS box" found at promotor region. Suppressor analysis for mutational specificity has revealed: (i) umuDC-independent mutagens, such as EMS and (oh)/sup 4/Cy, induce selected base substitution alone; and (ii) umuDC-dependent mutagens, such as X-rays and gamma-rays, induce various types of base substitution simultaneously, although they have mutational specificity. In the umuDC-dependent processes of base-change mutagenesis, the spectra of base substitution were a mixture of base substitution reflecting the specific base damages induced by individual mutagens and nonspecific base substitution. In conclusion, base substitution plays the most important role in umuDC-dependent mutagenesis, although mutagenesis of umuDC proteins remains uncertain.

46292 (KURRI-TR—279, pp 39-43) **Radiation sensitivity as a genetic factor in carcinogenesis.** Takebe, Hiraku. (Kyoto Univ., Japan. Faculty of Medicine). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780157. (CONF-8602138—).

From Symposium on fundamental problems in biological damage by radiation; Kumatori, Japan (21 Feb 1986).

It is known that some association exists between cancer-prone hereditary diseases and radiation sensitivity. In the case of ataxia telagiectasia (AT), frequencies of ionizing radiation-induced mutations are believed to be lower in AT fibroblast cells than in normal cells. When employing lymphoblastoid cells, the AT cells exhibited the same gamma-ray-induced mutation rates in proportion to doses as the normal cells. Nevertheless, it is concluded that the AT cells do not exhibit induced mutations so readily as the normal cells, taking high sensitivity of AT cells to gamma-rays into account. This conclusion has led to concern about the relationship between carcinogenesis and mutation. To elucidate this, quantitative studies on mutation of oncogenes are required. It is also pointed out that the mechanism of cancer-prone hereditary diseases is uncertain. High sensitivity of the cells to certain mutagens does not necessarily reflect deficiency in damage repair, suggesting the possibility that there might be no association between carcinogenesis and high sensitivity to ionizing radiation. It remains to be elucidated whether DNA repair is involved in radiation sensitivity in the case of cancer-prone hereditary diseases including AT, except for the case of xeroderma pigmentosum.

46293 **(KURRI-TR—279) Proceedings of the symposium on fundamental problems in biological damage by radiation.** Ikushima, Takaji (ed.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Aug 1986. vp. (In Japanese). (CONF-8602138—). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780157.

From Symposium on fundamental problems in biological damage by radiation; Kumatori, Japan (21 Feb 1986).

Items within the scope of EDB have been entered separately into the data base. (ACR)

46294 **(LBL—22169) Dosimetry of x-ray beams: The measure of the problem.** de Castro, T.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1986. Contract AC03-76SF00098. 18p. (CONF-860891—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014080.

From Denver X-ray conference; Denver, CO, USA (4 Aug 1986).

This document contains the text of an oral presentation on dosimetry of analytical x-ray equipment presented at the Denver X-Ray Conference. Included are discussions of sources of background radiation, exposure limits from occupational sources, and the relationship of these sources to the high dose source of x-rays found in analytical machines. The mathematical basis of x-ray dosimetry is reviewed in preparation for more detailed notes on personnel dosimetry and the selection of the most appropriate dosimeter for a specific application. The presentation concludes with a discussion common to previous x-ray equipment accidents. 2 refs. (TEM)

46295 **(NUREG/CR—4418) Dose calculation for contamination of the skin using the computer code VARSKIN.** Traub, R.J.; Reece, W.D.; Scherpelz, R.I.; Sigalla, L.A. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Aug 1987. Contract AC06-76RL01830. 100p. (PNL—5610). NTIS, PC A05/MF A01 - GPO. File Number TI87014051.

This report describes a method for computing the radiation dose to the skin from radioactive contamination on the skin. The method is based on tables of absorbed energy distributions around point sources in water. The method has been implemented in a computer code, VARSKIN, that will compute the radiation dose at a specified depth in the skin from a radiation source ranging in size from a point to a disc having a 100-cm^2 area. This report contains a source code listing of the computer code and tables of dose factors that have been derived from the code, as well as sample runs and user instructions. This report also discusses the contamination level that corresponds to the recording level described by the International Commission on Radiological Protetion. 33 refs., 4 figs., 4 tabs.

46296 (SAAS—343, pp 35-44) **Influence of the kind of the compound to be applied on metabolic kinetics and biological reaction of the radionuclides.** Moskalev, Yu.I.; Burgyshev, P.F.; Vasilenko, I.Ya.; Kalistratova, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780162. (CONF-8509389—Pt.3).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

Peculiarities of metabolic kinetics and biological reactions of various ^{14}C-labelled compounds (e.g. Na_2CO_3, K_2CO_3, $CaCO_3$, glucose, glycine, valine, tryptophan, palmitic acid, stearic acid), ^{7}Be-labelled compounds (chloride, fluoride, sulfate, nitrate, hydroxide) and ^{125}I-labelled sodium salts and deoxyuridine in mice and rats are

presented. The toxicity of ^{13}C-labelled inorganic compounds was essentially lower than that of organic ones. The accumulation of beryllium compounds in the main depot organs was, to a great extent, dependent on the kind of the compound applied. The quantity of the isotope carrier and the kind of the compound to be applied had no influence on the nature of distribution of the absorbed part of Be in puberal rats, but there were age-dependent differences. The kind of compound had no essential influence on late effects caused by ^{125}I.

46297 (SAAS—343, pp 45-52) **Influence of certain chemical substances on the accumulation of radioactive silver and cobalt in rats.** Ivannikov, A.T.; Tikhonova, L.I.; Borisov, V.P.; Popov, B.A.; Razumovskij, N.O. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780162. (CONF-8509389—Pt.3).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

With regard to reduced absorption and accelerated removal of incorporated radionuclides as the main ways to diminish the biological effect of these nuclides, experiments with radioactive silver and cobalt isotopes were performed in laboratory rats; with silver an obvious elimination of the nuclide was detected for thiols, penicillamine and diene; with cobalt chelating agents, especially DTPA, were most effective. The absorption of cobalt from the gastrointestinal tract was influenced by the sorbent ferrocene. Correlations between the effectivness of the agents, the chemical nature of the radionuclides and the stability of the chelates obtained could be ascertained in comparison to their stability in the process of interaction with biological components.

46298 (SAAS—343, pp 19-24) **Justification of methodical procedures for the optimization of radiation protection in reproductive women.** Liberman, A.N.; Zynova, I.A. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780162. (CONF-8509389—Pt.3).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

Scientific information on the influence of low-dose ionizing radiation on human embryos and fetuses is analyzed and the risk of irradiation in the different weeks of pregnancy is estimated quantitatively. Program and methods of follow-up in occupationally exposed reproductive women are justified. Emphasis is laid on methods estimating the condition of reproductiveness. Measures concerning prophylaxis and radiation protection of occupationally exposed women are investigated.

46299 (SAAS—343, pp 3-18) **Radiological survey in pediatric X-ray diagnostics.** Menzel, B.; Steuer, J.; Ivanov, E.V.; Nikitin, V.V.; Kal'nitzkij, S.A.; Masarskij, L.I. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin, German Democratic Republic). 1986. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780162. (CONF-8509389—Pt.3).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

The qualifications and working behavior of the personnel as well as parameters of radiation physics and instrumentation influence radiation exposure of patients in pediatric X-ray diagnostics. First, experimental results on organ doses in examinations of thorax and abdomen are presented and suggestions for the development of a comprehensive method of dosimetry by means of experimental data are made. Measures for improvement of radiation protection in pediatric X-ray diagnostics are proposed.

46300 **(UCD—472-131) Annual report of the Energy-Related Health Research Program of the University of California, Davis, 1985.** (California Univ., Davis (USA). Lab. for Energy-Related Health Research). Jun 1987. Contract AC03-76SF00472. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013978.

This report summarizes research activities for the period from 1 October 1984 to 30 September 1985 at the Laboratory for Energy-related Health Research (LEHR). The report has been divided into several topical sections outlining the scope of research at LEHR including Radionuclide Toxicity Studies, External Radiation Effects Studies, Skeletal Biology Studies, Cellular and Molecular Studies, Physical and Chemical Studies, and Nuclear Medical Studies. The individual studies reported here have been separately abstracted and entered into the Energy Data Base.

46301 **Radiation carcinogenesis: time-dose relationships.** Ullrich, R.L.; Jernigan, M.C.; Satterfield, L.C.; Bowles, N.D. (Oak Ridge National Lab., TN). *Radiation Research;* **111**: No. 1, 179-184(Jul 1987).

The present studies were undertaken to examine the time-dose relationships for the induction of lung adenocarcinomas and mammary adenocarcinomas in female BALB/c mice following gamma irradiation. Twelve-week-old female BALB/c/An NBd mice were irradiated with ^{137}Cs gamma rays, and lifetime tumor incidences following high-dose-rate, low-dose-rate, or fractionated exposure regimens were compared. Analysis of the results indicated that the data could be fitted by linear-quadratic dose-response models for the induction of both tumors following acute doses and a linear model with a slope similar to that for the linear portion of the linear quadratic following low-dose-rate exposure regimens. When doses were fractionated the response was dependent upon the dose per fraction. If the dose per fraction was a dose which was predominantly on the linear portion of the acute dose response curve, then the response was linear and similar to that after low-dose-rate exposures. If the dose per fraction was in a region where the quadratic portion of the acute dose-response was significant, then the tumor incidence was higher than that following low-dose-rate exposures.

46302 **Neutron RBEs and the radiosensitive target for mouse immature oocyte killing.** Straume, T.; Dobson, R.L.; Kwan, T.C. (Lawrence Livermore National Lab., CA). *Radiation Research;* **111**: No. 1, 47-57(Jul 1987).

The highly radiosensitive immature oocytes of mice were irradiated in vivo with graded doses of ^{252}Cf fission radiation, 0.43- or 15-MeV neutrons, or ^{60}Co gamma rays. Comparisons of oocyte survival for neutrons and for gamma rays demonstrate that neutron RBEs for the killing of these important cells do not reach the high values (30-50 or more) at low doses observed for several other biological end points. Rather, neutrons differ little in effectiveness from gamma rays in killing these extremely sensitive murine oocytes. For 0.43-MeV neutrons, RBEs obtained from fitted survival curves reach only 1.7 at 0.1 rad. For 15-MeV neutrons, they are not significantly different from 1 at any dose tested (lowest, 4.5 rad). For ^{252}Cf fission neutrons (E = 2.15 MeV), RBEs are intermediate between those for 0.43- and 15-MeV neutrons. For all neutron energies tested, the RBEs are particularly low in the juvenile period, a time when murine immature oocytes are especially radiosensitive. With exposure just prior to birth, however, when these cells are much less easily killed, higher, more usual RBEs are found. The minimum size of the lethality target in mouse immature oocytes, estimated from the inactivation constant for 0.43-MeV neutrons and microdosimetric values, is larger than the nucleus but not larger than the cell. This and related analytical considerations suggest that the hypersensitive target in these particular oocytes is the plasma membrane, a finding which is in excellent accord with results from other experiments using different, contrasting radiations and dose deliveries (accelerated Si14+ ions, gamma rays, and beta rays from ^{3}HOH compared with those from [^{3}H]thymidine).

5602 Thermal Effects

REFER ALSO TO CITATION(S) 46239

46303 **Implantable apparatus for localized heating of tissue.** Doss, J.D. (to Dept. of Energy, Washington, DC). US Patent 4,679,561. 14 Jul 1987. Filed date 20 May 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An apparatus is described for locally increasing the temperature of living tissue located inside of a body. The apparatus com-

prises: a. means disposed externally to the body for generating radio-frequency electromagnetic energy having a chosen intensity; b. first antenna means for receiving and for radiating the radio-frequency electromagnetic energy from the means for generating radio-frequency electromagnetic energy; the first antenna means is adapted for placement at substantially the closest location external to the body to the tissue to be heated; c. second antenna means closely coupled to the first antenna means for receiving the radiated electromagnetic energy and for generating an alternating voltage having a first electrical connection and a second electrical connection. The second antenna means is adapted for location within the body near an accessible outer surface in order to facilitate receiving the radiated electromagnetic energy.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 44886, 44986, 45073, 45543, 45685, 46160, 46163

46304 **(AD-A—181455/7/XAB) Finite-difference modeling of seismological problems in magnitude estimation using body waves, surface waves, and seismic source imaging. Final report, 11 February 1985-10 February 1987.** McLaughlin, K.L.; Der, Z.A.; Jih, R.S.; Lees, A.C.; Anderson, L.M. (Teledyne Geotech, Alexandria, VA (USA). Alexandria Labs.). Mar 1987. 39p. (TGAL—87-01). NTIS, PC A03/MF A01.

Contents include: boundary conditions for arbitrary polygonal topography in a 2-d elastic finite-difference scheme for seismogram generation; teleseismic spectral and temporal m_b and psi/sub infinity/ estimates for four French explosions in southern Sahara; scattering from near-source topography: teleseismic observations and numerical 2-d explosive line-source simulations; effects of local geologic structure on Yucca Flats, NTS, explosion waveforms: 2-dimensional linear finite-difference simulations; and finite-difference simulations of Rayleigh-wave scattering by 2-d rough topography.

46305 **(DOE/ER/60076—T1) Pulmonary metabolism of dibenz(a,j)acridine: A carcinogenic heterocyclic aromatic: Informal technical progress report for period October 1, 1983-December 31, 1984.** Warshawsky, D. (Cincinnati Univ. Medical Center, OH (USA). Dept. of Environmental Health). 31 Jan 1985. Contract AC02-82ER60076. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014163.

Metabolic profiles for dibenz(a,j)acridine in perfused lung are provided. (DT)

46306 **(DOE/EV/05888—T3) The impact of energy-related pollutants on chromosome structure: Final report, January 1, 1984-December 31, 1986.** Rill, R.L. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 1987. Contract AS05-78EV05888. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013056.

Three projects are described. The structure of nucleosome cores was studied using chymotrypsin as a probe of hydrophobic residues accessible on the core surface showed that only leu-20 of H3 was readily accessible, although other core histones were ultimately cleaved. Primary sites of cleavage of H2a, H2b, and H4 were identified. Carbon-13 NMR spectroscopic methods were used to examine nucleosome cores and that about 10% of histone amino acid residues are contained in termini that are highly mobile. The major mobile segments were identified as amino terminal regions of H3 and H2a, plus a carboxy-terminal region of H2a. NMR studies of oligonucleosomes showed that these termini are not immobilized by binding to nucleosome linkers in certain higher order levels of chromatin structure. We have shown that nucleosome core length DNA forms cholesteric and other liquid crystalline phases at approximately physiological concentrations in simple saline solutions. Microscopic and NMR spectroscopic methods were used to identify liquid crystalline phases and to establish phase diagrams for transitions between phases as functions of DNA concentration and temperature. We have examined the sequence specificities of binding of bis-(o-phenanthroline) Cu(I) complex (CuOP), acetylacetoxyaminofluorene (AAAF), (+-)-anti-benzo(a)pyrene dihydrodiol epoxide (BPDE), methylene blue, and acridine orange to H3 and H2a genes. The first three chemicals bound non-randomly to DNA, while latter two bound nearly randomly. A preliminary map of binding sites of CuOP, AAAF, and BPDE in and near the H3 gene showed that several sequence regions were bound preferentially by two or more or these chemicals. CuOP appeared to exhibit the most specificity. All sites of high CuOP preference were also reactive towards AAAF and/or BPDE. 1 fig.

46307 **(EPRI-EA—5359) Risk assessment of toxic emissions: Alternative models and practices: Final report.** Bolten, J.G.; Morrison, P.F.; Solomon, K.A.; Wolf, K.A. (RAND Corp., Santa Monica, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1987. 250p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920557.

This report expands on a previously described general methodology for assessing the control costs and chronic health risks of toxic pollutant emissions from coal-fired electric power plants. It discusses (1) alternative models for the general risk assessment framework, (2) simplified environmental transport models that may be used for initial analysis, and (3) the implications of certain assumptions used in the exposure analysis. Moreover, it describes the application of the methodology, including the simplified models, to a case study of selenium emissions from a coal-fired power plant.

46308 **(GSF-EXP—9) Effects of realistic combinations of SO/sub 2/, NO/sub 2/ and ozone on Sitka spruce.** Blank, L.W.; Roberts, T.M. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.); Central Electricity Research Labs., Leatherhead (UK)). 1985. 8p. (CONF-8410476—1). NTIS, PC E07; Available from NTIS as TIB/B87-10488.

From International symposium on air pollution and stability of coniferous forest ecosystems; Brno, Czechoslovakia (1 Oct 1984).

Small individuals of eight clones of Picea sitchensis were used for the fumigation experiments. Twenty plants per clone were available and exposed to four concentration levels of SO/sub 2/, NO/sub 2/ and O/sub 3/. Statistically significant effects of fumigation only occurred on two clones and only on the highest SO/sub 2/ concentrations.

46309 **(NP—7770265) Lead and cadmium contents in the odontolith of workers of a cement factory.** Ohneis, M.S. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 14 Nov 1985. 78p. (In German). NTIS (US Sales Only), PC A05. File Number DE87770265.

Investigations aimed at determining the lead and cadmium contents in the odontolith of workers of a cement factory and at comparing the results with a control group without occupational exposure to heavy metals. The lead and cadmium contents in the tartar were determined experimentally in 60 workers from a cement factory and in 54 patients from a dental practice. Atomic absorption spectrometry executed without flame in the graphite tube was used as the trace analysis method. The analysis values achieved were evaluated statistically. The comparison of lead concentrations in the tartars of the workers and the controls revealed no difference. When considering the smoking habits of the controls, the lead content in the smokers' tartar was found to be significantly high. Increased lead contents were found in the tartars of smoking workers, too. Their values were higher than those of non-smoking workers. The comparison of cadmium concentrations showed no difference between the workers and the controls. Again, more cadmium was detected in the tartars of smoking controls than in the non-smoking controls. The tartars of non-smoking and smoking workers showed no difference as to cadmium concentrations. These findings were compared with the data provided by studies performed in recent years.

46310 **(NP—7770266) Acute and chronic intoxication with cadmium - a comparative study of intoxication symptoms.** Gruschinske, H.P. (Freie Univ. Berlin (Germany, F.R.)). 13 Jul 1983. 88p. (In German). NTIS (US Sales Only), PC A05. File Number DE87770266.

With the help of symptoms described in the literature on chronic intoxications and with the help of the casuistry of an acute peroral cadmium intoxication, symptomatic patterns of both cases could be described. The differences between the two symptomatic

patterns are: 1. in the toxicodynamics and toxicokinetics of Cadmium, and 2. in the therapy possibilities and prognosis. The chronic intoxication shows purely toxic organ changes with reproducible distribution patterns of concentrations in the organs, whereas the acute intoxication shows a coexistence of toxic and shock-related organ changes, whereby the hierarchy of organ concentrations shows a discrepancy between functional damage and the level of organ concentration. A therapy concept which is based on observation of an acute peroral intoxication resulting in death is recommended.

46311 **(PB—87-198487/XAB) Differing response of asthmatics to sulfur dioxide exposure with continuous and intermittent exercise.** Kehrl, H.R.; Roger, L.J.; Hazucha, M.J.; Horstman, D.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 29 Aug 1986. 8p. (EPA—600/J-87/026). NTIS, PC A02/MF A01.

Pub. in American Review of Respiratory Diseases, No. 135, 350-355(1987).

Ten mild asthmatics were initially exposed in an environmental chamber (26 C, 70% RH) to clean air and 1.0 ppm sulfur dioxide while performing three sets of 10 minutes treadmill exercise (ventilation = 41 1/min) and 15 minutes rest. To evaluate the effects of the pattern and duration of exercise on the response to sulfur dioxide exposure, the subjects were then exposed to the same environmental conditions, while exercising continuously for 30 minutes. Specific airways resistance (SRaw) was measured by body plethysmography prior to exposures and after each exercise. All SRaw responses with sulfur dioxide exposure were significantly different than the clean air responses. It appears that asthmatics show an attenuated response to repetitive exercise in a 1.00 ppm sulfur dioxide atmosphere and that the response to sulfur dioxide exposure develops rapidly and is maintained during 30 minutes continuous exercise.

46312 **(PB—87-199915/XAB) Study of the effects of oil on marine turtles.** (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 352p. NTIS, PC PC E99.

Set includes PB—87-199923 through PB—87-199949.

46313 **(PB—87-199923/XAB) Study of the effects of oil on marine turtles. Volume 1. Executive summary. Final report, 30 September 1983-1 October 1985.** Vargo, S.; Lutz, P.; Odell, D.; Van Vleet, E.; Bossart, G. (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 28p. NTIS, PC A03/MF A01.

See also Volume 2, PB—87-199931; Also available in set of 3 reports PC E99, PB—87-199915.

The objective of the study was to determine the effects of oil on marine turtles. An experimental program was carried out on 3-20 month old loggerhead and 3-16 month old green turtles to determine behavioral and physiological effects of oil using South Louisiana Crude Oil (SLCO) preweathered for 48 hrs. The behavioral experiments indicated that both species of marine turtles had a limited ability to avoid oil slicks, but experiments to determine avoidance/attraction to floating tar balls were inconclusive. The physiological experiments showed that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of 15-18 month old loggerhead sea turtles were significantly affected.

46314 **(PB—87-199931/XAB) Study of the effects of oil on marine turtles. Volume 2. Technical report. Final report, 30 September 1983-1 October 1985.** Vargo, S.; Lutz, P.; Odell, D.; Van Vleet, E.; Bossart, G. (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 197p. NTIS, PC A09/MF A01.

See also Volume 1, PB—87-199923 and Volume 3, PB—87-199949; Also available in set of 3 reports PC E99, PB—87-199915.

The objective of the study was to determine the effects of oil on marine turtles. An experimental program was carried out on 3-20 month old loggerhead and 3-16 month old green turtles to determine behavioral and physiological effects of oil using South Louisiana Crude Oil (SLCO) preweathered for 48 hrs. The behavioral experiments indicated that both species of marine turtles had a limited ability to avoid oil slicks, but experiments to determine avoidance/attraction to floating tar balls were inconclusive. The physiological experiments showed that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of 15-18 month old loggerhead sea turtles were significantly affected. Spills in the vicinity of nesting beaches are of special concern.

46315 **(PB—87-199949/XAB) Study of the effects of oil on marine turtles. Volume 3. Appendices. Final report, 30 September 1983-1 October 1985.** Vargo, S.; Lutz, P.; Odell, D.; Van Vleet, E.; Bossart, G. (Florida State Univ., St. Petersburg (USA). Inst. of Oceanography). 15 Sep 1986. 127p. NTIS, PC A07/MF A01.

See also Volume 2, PB—87-199931; Also available in set of 3 reports PC E99, PB—87-199915.

The objective of the study was to determine the effects of oil on marine turtles. An experimental program was carried out on 3-20 month old loggerhead and 3-16 month old green turtles to determine behavioral and physiological effects of oil using South Louisiana Crude Oil (SLCO) preweathered for 48 hrs. The behavioral experiments indicated that both species of marine turtles had a limited ability to avoid oil slicks, but experiments to determine avoidance/attraction to floating tar balls were inconclusive. The physiological experiments showed that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of 15-18 month old loggerhead sea turtles were significantly affected.

46316 **(PB—87-203337/XAB) Bioavailability of polychlorinated dibenzo-p-dioxins and dibenzofurans from contaminated Wisconsin River sediment to carp.** Kuehl, D.W.; Cook, P.M.; Batterman, A.R.; Lothenbach, D.; Butterworth, B.C. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1987. 15p. (EPA—600/J-87/035). NTIS, PC A02/MF A01.

Pub. in Chemosphere, Vol. 16, No. 4, 667-679(1987).

The bioavailability of 2,3,7,8-TCDD from sediment to freshwater fish was studied in laboratory exposures. Carp (10g) exposed to Wisconsin River sediment (39pg/g) for 55 days accumulated 7.5 pg/g. Maintaining exposured fish in clean water for an additional 205 days resulted in depuration of 32-34% TCDD. These values compare to field data where sediments ranged from 30-200 pg/g and 1.5 kg carp (70 pg/g) depurated 55% in 325 days. Analysis of sediment, laboratory-exposed fish, and Wisconsin River fish for other PCDDs and PCDFs showed residues of 2,3,7 and 8-substituted congeners selectively enriched.

46317 **(PB—87-203394/XAB) Mutagenicity in Salmonella of hazardous wastes and urine from rats fed these wastes.** DeMarini, D.M.; Inmon, J.P.; Simmons, J.E.; Berman, E.; Pasley, T.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Jun 1987. 29p. (EPA—600/D-87/208). NTIS, PC A03/MF A01.

Fifteen hazardous industrial waste samples were evaluated for mutagenicity in the Salmonella plate-incorporation assay using strains TA98 and TA100 in the presence and absence of Aroclor 1254-induced rat liver S9. Dichloromethane/methanol extracts of the crude wastes also were evalauted. Seven of the crude wastes were mutagenic, but only 2 of the extract of these 7 wastes were mutagenic; extracts of 2 additional wastes also were mutagenic. In addition, 10 of the crude wastes were administered by gavage to F-344 rats, and 24-H urine samples were collected. Of the 10 raw urines evaluated, 3 were mutagenic in strain TA98 in the presence of S9 and B-glucuronidase. To the authors' knowledge, this is the first report of the mutagenicity of urine from rodents exposed to hazardous wastes. Based on the present results, the use of only strain TA98 in the presence of S9 might be adequate for general screening of hazardous wastes or waste extracts for genotoxicity.

46318 **(PB—87-205142/XAB) Toxicity testing of drilling fluid: further studies of quartz-containing viscosifier on rat lung.** White, L.; Gylseth, B.; Bjoerseth, O. (SINTEF, Trondheim (Norway)). 11 Dec 1986. 33p. (STF—21-A86107). NTIS, PC PC E04/MF E04.

The viscosifier of a low-aromatic drilling fluid contains crystalline quartz, a lung toxicant. The quartz constituted 4.4% of the bulk sample of the viscosifier, but is increased to 7.5% in a respirable sample. Instillation of the viscosifier into rat lung causes an acute inflammation attributable to the quartz. However, the effects from a comparatively high dose recede during a period of 4 months. It is concluded that there is no progressive toxicity in rat lung from the quartz fraction at this dose, and therefore that under normal handling conditions, the viscosifier should not pose a respiratory hazard to workers.

46319 **(UCRL—15831) Health risk assessment of tetrachloroethylene (PCE) in California drinking water.** Bogen, K.T.; Hall, L.C.; McKone, T.E.; Layton, D.W.; Patton, S.E. (Lawrence Livermore National Lab., CA (USA)). 10 Apr 1987. Contract W-7405-ENG-48. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87013493.

This document presents an assessment of the potential health risks associated with exposure to tetrachloroethylene (also known as perchloroethylene or PCE) dissolved in California drinking waters. A primary goal of this health-risk assessment is to evaluate dose-response relationships for observed and potential toxic end points of PCE in order to define dose rates that can be used to establish standards that will protect members of the general public from adverse health effects resulting solely from water-based exposures to PCE. We also analyze the extent of human exposures attributable to PCE-contaminated ground water in California.

46320 **Organization of amplified metallothionein (MT) genes in cadmium-resistant Chinese hamster cells.** Hildebrand, C.; Grady, D.; Meincke, L.; Clark, L.; Qui, X.; Fehrenbach, S.; Brown, N.; Jones, M.; Longmire, J.; Moyzis, R. (Los Alamos National Lab., NM). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **46**: No. 6, 1948(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

In the parental, cadmium-sensitive, CHO cells, two MT genes (MT-I and II) have been cloned and shown to encompass ~9 Kb of DNA. Both genes demonstrate the canonical intron-exon organization observed for other mammalian MT genes. Chromosome walking has been employed to study the organization of the MT genes in amplified cell lines. Using DNA from a highly-amplified cell line, Cd/sup r/ 200 T1, a genomic library was constructed in λ Ch35 by standard procedures. Recombinants containing sequences complementary to a MT-II cDNA probe were isolated and characterized. Restriction enzyme analyses of these recombinants have extended the map of the MT-I and II gene region to encompass ~35 Kb of DNA and indicate stability of the amplified genome over this region. A single SacII restriction site has been identified at the extreme 3′ end of the cloned region. Since SacII is an infrequently-cutting restriction enzyme, accelerated long-range restriction mapping of the amplified MT gene region will be possible by combining chromosome walking in the MT gene region with large fragment separation using field-in-version gel electrophoresis.

46321 **Permissible concentrations of chemicals in air and water derived from RTECS entries: a rash chemical scoring system.** Jones, T.D.; Walsh, P.J.; Zeighami, E.A. (Oak Ridge National Lab., TN). *Toxicology and Industrial Health;* **1**: No. 4, 213-234(Dec 1985).

Many chemicals are of concern to human health, but only a few have epidemiologically derived risk estimates. About 45,000 chemicals are listed in RTECS, most of which have had some testing in subhuman models. RTECS entries range from cellular effects through organoleptic damage to lethality, with many pathological endpoints listed, including mutagenic changes, irritation, teratogenesis, cancer, mortality, etc. However, it is difficult to extend any biological test results to human risk assessments. If the results are extended, the degree of validity is highly uncertain. This paper describes a logical basis for using the entire complex spectrum of test results to evaluate the overall toxicological potency of a chemical to be assayed (i.e., an interviewing chemical) and describes how to derive tentative, permissible concentrations in air and water for any particular chemical for which no regulatory guidance exists. This approach has been tested for 16 reference chemicals discussed in NIOSH Criteria Documents, EPA-CAG reports, etc. The evaluations are uncomplicated, but occasionally it is difficult to match RTECS entries for two different chemicals. Difficult comparisons may require some familiarity with experimental design and the toxicological literature. One important product of this novel approach is that a distribution or array of potency values is obtained for any chemical evaluated. This distribution reflects many uncertainties stemming from low statistical power, experimental design, pharmacological processes, interspecies variability, dose rate, biological effect monitored, route of treatment, etc. The array of relative values for a particular chemical reflects many different biological and physical conditions. The distribution of the array helps to index a composite toxicological profile for many different biological effects resulting from numerous treatment protocols.

46322 **Morphological transformation induced by chemical carcinogens is enhanced by the biologically active metabolite of vitamin D_3, 1α,25-dihydroxycholecalciferol.** Jones, C.A.; Callaham, M.F.; Huberman, E. (Argonne National Lab., IL). *Proceedings of the American Association for Cancer Research;* **25**: 138(Mar 1984).

The active metabolite of vitamin D_3, 1α,25-dihydroxycholecalciferol [1,25-$(OH)_2D_3$] was found to increase the frequency of morphologically transformed colonies induced by chemical carcinogens in the hamster embryo cell transformation assay. Treatment of the embryo cells with either benzo(a)pyrene, (+/-) 7β,8α-dihydroxy-9α,10α-epoxy-7,8,9,10-tetrahydrobenzo(a)pyrene or N-methyl-N′-nitro-N-nitrosoguanidine for 3 days followed by treatment of the cells with 1,25-$(OH)_2D_3$ for 4 days resulted in an increase in the transformation frequency compared to cells treated with the carcinogen only. Reversing the order of the treatment (i.e., incubating the cells with 1,25-$(OH)_2D_3$ prior to benzo(a)pyrene treatment) did not result in such an enhancement. Vitamin D_3 and 24,25-dihydroxycholecalciferol, another metabolite of this vitamin, also enhanced the frequency of cell transformation but were less potent than 1,25-$(OH)_2D_3$. Pyrene, which is not carcinogenic, did not induce transformed colonies, nor did the combination of pyrene and 1,25-$(OH)_2D_3$ treatment result in the development of such colonies. Benzo(e)pyrene [B(e)P], which is considered as either an inactive or weak carcinogen, was also ineffective in inducing transformed colonies. However, in the two-stage protocol when B(e)P was used with 1,25-$(OH)_2D_3$, the authors observed a significant number of transformed colonies. These studies demonstrate that 1,25-$(OH)_2D_3$ resembles phorbol 12-myristate 12-acetate in its capacity to enhance morphological transformation in carcinogen-treated hamster embryo cells. These results suggest that this vitamin D_3 metabolite may act as a natural promoter of carcinogenesis in fibroblastic cells.

46323 **Specific nuclear antigens expressed in differentiating human myeloid leukemia cells.** Huberman, E.; Murao, S.I.; Epstein, A. (Argonne National Labs., IL). *Proceedings of the American Association for Cancer Research;* **25**: 44(Mar 1984).

The expression of three granulocyte-specific and two granulocyte-monocyte-specific nuclear antigens was detected by immunofluorescence with murine monoclonal antibodies in a series of human myeloid (HL-60, ML-2, KG-1, and B-III) and monocytic (THP-1) leukemia cells treated with chemical inducers of cell differentiation. Treatment of the promyelocytic HL-60 cells with dimethyl sulfoxide or retinoic acid induced the cells to acquire a granulocyte-like phenotype, while treatment of these cells with phorbol-12-myristate-13-acetate or 1,25-dihydroxyvitamin D_3 induced a phenotype that resembled that of monocytes-macrophages. The granulocyte-like phenotype was associated with the maintenance of one of the granulocyte-specific nuclear antigens and induction of the other four nuclear antigens. The monocytic-macrophage phenotype was associated with an increased expression of the granulocyte-monocyte-specific nuclear antigens but not of the granulocyte-specific antigens. The ML-2 and THP-1 cells were also susceptible to induction of cell differentiation and to changes in the expression of the nuclear antigens but to a lesser degree than were the HL-60 cells. The less differentiated KG-1 and B-II myeloid cells were either not responsive or responded only in a limited degree to the induction of cell differentiation or changes in the nuclear antigens. The authors suggest that the reactivity of cells with mono-

clonal antibodies to specific nuclear antigens can be used as a maturational marker in cell differentiation studies. Furthermore, nuclear antigens expressed early in cellular differentiation may provide information about changes in regulatory elements in normal and malignant cells.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 45734

46324 **(AD-A—181551/3/XAB) Biological applications and effects of optical masers. Annual report, 16 March 1985-15 March 1986.** Ham, W.T.; Mueller, H.A.; Ruffolo, J.J.; Cleary, S.F.; Guerry, R.K. (Medical Coll. of Virginia, Richmond (USA). Dept. of Physiology and Biophysics). Mar 1987. 14p. NTIS, PC A02/MF A01.

Evidence that superoxide dismutase (SOD) enhances and catalase (CAT) reduces blue light toxicity in the monkey retina when injected intravenously (i.v) was inconclusive, and it is surmized that i.v. injection is ineffective because these large enzymes have a short lifetime in the circulation and cannot penetrate the blood-retinal barrier. Repetitive eye exposures of trained monkeys to the borad spectrum 330-420 nm were terminated in February 1985 after 1,171 daily exposures in one animal and 584 in the other animal. To date, no lenticular anomalies have been noted. Both monkeys are being maintained in good health and examined with the biomicroscope at frequent intervals. Repetitive daily exposures for 21 days of 440, 475, and 533 nm light at the same retinal site in 3 monkeys have shown that photic maculopathy is cumulative on a daily basis, especially for 440-nm light. In one monkey, daily radiant exposures of 2.8 $J.cm^{-2}$ resulted in the appearance of a lesion on the 20th day. Histologic data are presented for retinal lesions produced by 40-microsecond pulses of 647-nm laser light at a pulse repetition frequency (PRF) of 1600 Hz. Exposures were 10 s in duration at a peak power to the cornea of the monkey eye of 43 nW. The results are unusual in that the photoreceptors above the reinal pigment epithelium (RPE) are completely ablated. Possible mechanisms are discussed.

46325 **(PB—87-200598/XAB) Developmental and teratogenic effects of 2450-MHz microwaves in mice. Final report.** Szmigielski, S.; Chazan, B. (Instytut Matki i Dziecka, Warsaw (Poland)). 1986. 64p. NTIS, PC A04/MF A01.

The report describes results of experimental investigations performed during 1982-1985 which indicate that exposure of pregnant mice to nonthermal 2450-MHz microwave fields during the whole period of gestation did not influence the course and outcome of pregnancy. However, both loss of early pregnancy and development of malformations are possible after exposure to thermal fields. An original finding from the investigations is enhancement of teratogenic potency of cytosine arabinoside (ara-C) in pregnant mice exposed to non-thermal 2450-MHz microwave fields. In another investigation, female and male mice (parents) were exposed to nonthermal 2450-MHz microwave fields for 3-5 months (2 hr daily) prior to fertilization. It was found that exposure of parents to microwaves may influence both the course and outcome of pregnancy.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 46711

46326 **(ECRC/M—2152) Health problems associated with air conditioning: a study tour of the USA.** Brundrett, G.W.; Eddyshaw, J. (Electricity Council Research Centre, Capenhurst (UK)). Jun 1987. 16p. Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK .

There are two worries concerning air conditioned buildings. One is the growing frequency of Legionnaire's disease epidemics and the other is the sick building syndrome. The results of a survey of the leading authorities in the US, in these fields, to seek guidance on how the problem should be tackled and is being tackled, are presented.

58 GEOSCIENCES

5801 Geology And Hydrology

46327 **(DOE/ER—0329) Field facilities for subsurface transport research.** Luxmoore, R.J.; Abner, C.H. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013999.

Field installations for research on the roles of macropores and the spatial variability of soil physical and chemical characteristics in subsurface transport of water and solutes are described. Facilities for transport studies dominated by one-, two-, and three-dimensional flow processes provide a comprehensive approach to quantifying the contributions of precipitation (new) and antecedent (old) water to subsurface transport for a range of hydrologic conditions. A computer data acquisition system for intensively monitoring subsurface flow rates, perched water table dynamics, and soil water potentials also has capability for data analysis during precipitation events. Two small watershed areas (~0.5 ha) with deciduous forest vegetation but with contrasting soil profile development (3-m vs 25-m depth to bedrock) have been similarly instrumented with these installations for comparative studies. Scientists interested in subsurface transport processes are invited to develop cooperative projects using these watershed facilities. Experimental and simulation modeling methods may be used to test hypotheses or evaluate concepts.

46328 **(DOE/ER/60197—H1) On the surging potential of polar ice streams: Antarctic surges: A clear and present danger?.** Radok, U.; Jenssen, D.; McInnes, B. (Colorado Univ., Boulder, (USA). Cooperative Inst. for Research in Environmental Sciences; Melbourne Univ., Parkville (Australia)). Jul 1987. Contract AC02-84ER60197. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013980.

Antarctic ice streams typically move hundreds of meters in a year. This investigation was carried out to determine whether polar ice streams can accelerate their motion from time to time by one or two orders of magnitude in the span of a few years, with appreciable effects on global sea level. The mass gains and losses of the Antarctic ice sheet as a whole closely balance one another. Three-dimensional steady-state fields of ice velocity and temperature in broad agreement with the as yet very scant observational record for the ice sheet. A numerical model which links the sliding motion of the ice to the energy dissipated by the friction between the ice and the underlying rock, was used to simulate the time-dependent behavior of eight ice streams representing the full range of Antarctic conditions. In contrast to the realistic alternation between fast advances and stagnating retreats which the model had produced for some mountain glaciers known to surge, the modeled ice streams instead went from steady to irregular continuous fast sliding when the prescribed ice deformability was reduced and/or the implied lubrication by frictional heating was increased. Substantial rapid advances did not develop, except as transient phases in two experiments. The inability of the model in general to create surges in ice streams could be due solely to its over-simplified treatment of the complex hydraulic processes taking place below the ice. More adequate treatments of these processes are being developed and, when expanded into new self-propelled models, could show ice stream surges to be feasible.

46329 **(IS-T—1334) The origin of manganese-rich metasediments and their relationship to iron formation and base metal deposits, western Georgia piedmont.** Wonder, J.D. (Ames Lab., IA (USA)). Aug 1987. 179p. NTIS, PC A09/MF A01. File Number DE87013597.

Manganiferous metasediments (coticules), banded iron-formation, and tourmaline-quartz rocks (tourmalinites) are found in close spatial association to each other and to volcanogenic base metal sulfide and gold deposits in the Northern Piedmont of western Georgia. Coticules, which consist of up to 90% garnet and contain from 1 to 15 weight % MnO and 14 to 37 % Fe_2O_3, are often hosted by metabasalt. Tourmalinites occur as poorly-bedded aggregates or disseminations and are also found locally associated with metaba-

salt. Trace element analyses of coticules yield conflicting results. Cu + Co + Ni values and Zr/Cr ratios are low and indicate a hydrothermal origin. Alumina concentrations, Y/P_2O_5% ratios, and Th values indicate the probable presence of pelagic sediments in the protolith. Rare earth element patterns are enriched in the light elements and have slight negative Eu anomalies, resembling the patterns of pelagic clays most closely. The protolith of coticules was apparently a hydrothermal sediment with pelagic and/or terrigenous input. Tourmaline in tourmalinites is chemically similar to stratabound sulfide-related examples. Both coticules and tourmalinites are interpreted as metamorphosed seafloor exhalative sediments and thus indicate the potential for the presence of genetically related ore mineralization.

46330 **(NUREG/CR—4937) Investigation of the Meers fault in southwestern Oklahoma.** Luza, K.V.; Madole, R.F.; Crone, A.J. (Oklahoma Univ., Norman (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Research). Aug 1987. 67p. NTIS, PC A04 - GPO. File Number DE87900980.

The Meers fault is part of a major system of NW-trending faults that form the boundary between the Wichita Mountains and the Anadarko basin in southwestern Oklahoma. A portion of the Meers fault is exposed at the surface in northern Comanche County and strikes approximately N. 60° W. where it offsets Permian conglomerate and shale for at least 26 km. The scarp on the fault is consistently down to the south, with a maximum relief of 5 m near the center of the fault trace. Quaternary stratigraphic relationships and 10 ^{14}C age dates constrain the age of the last movement of the Meers fault. The last movement postdates the Browns Creek Alluvium, late Pleistocene to early Holocene, and predates the East Cache Alluvium, 100 to 800 yr B.P. Fan alluvium, produced by the last fault movement, buried a soil that dates between 1400 and 1100 yr B.P. Two trenches excavated across the scarp near Canyon Creek document the near-surface deformation and provide some general information on recurrence. Trench 1 was excavated in the lower Holocene part of the Browns Creek Alluvium, and trench 2 was excavated in unnamed gravels thought to be upper Pleistocene. Flexing and warping was the dominant mode of deformation that produced the scarp. The stratigraphy in both trenches indicates one surface-faulting event, which implies a lengthy recurrence interval for surface faulting on this part of the fault. Organic-rich material from two samples that postdate the last fault movement yielded ^{14}C ages between 1600 and 1300 yr B.P. These dates are in excellent agreement with the dates obtained from soils buried by the fault-related fan alluvium.

46331 **Evidence from Rayleigh wave data for magma in an upper crustal dike in the Albuquerque-Belen basin of the Rio Grande rift, New Mexico.** Schlue, J.W.; Hostettler, K.K.; Edwards, C.L. (Department of Geoscience and Geophysical Research Center, New Mexico Institute of Mining and Technology, Socorro). *Journal of Geophysical Research;* 92: No. B9, 9281-9292(10 Aug 1987).

We have found evidence for a dikelike structure in the middle of the Albuquerque-Belen basin of the Rio Grande rift from our interpretation of two-station Rayleigh wave amplitude and phase velocity data. Two-dimensional finite element modeling suggests that the structure is about 200 m thick, extends vertically from a depth of about 2 1/2 km to at least 20 Km, and contains material characterized by a shear wave velocity of about 1/2 km/s. Simple physical arguments suggest that the length of the structure may be at least 28 km long. Nearby high heat flow values, historical swarmlike seismicity, recent (0.14 Ma) volcanism, and an extensive, sill-like magma body at midcrustal depths all suggest that the structure is a magma-filled dike. Source characteristics and seismometer response limit our reliable data to the frequency band of 0.08 Hz to 0.250 Hz; thus we cannot tell whether the dike is solely an upper crustal feature or whether it extends through the crust and (in)to the upper mantle. copyright American Geophysical Union 1987

5802 Geophysics

REFER ALSO TO CITATION(S) 44933, 46158, 46304

46332 **(DOE/ER/13336—2) CSDP: The seismology of continental thermal regimes: Final report for period April 1, 1986-April 1, 1987.** Aki, K. (University of Southern California, Los Angeles (USA). Dept. of Geological Sciences). Jul 1987. Contract FG03-85ER13336;AC02-76ER02534. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014100.

This report describes progress in the study of both wave propagation in complex structures and source mechanism of geothermal seismic events. The following work was accomplished in the past one-year period: (1) interpretation of long-period events observed at Mt. St. Helens and at the Fenton Hill hot-dry-rock experimental site in terms of seismic radiation from a fluid-filled crack; (2) interpretation of teleseismic data collected in and near the Valles caldera in terms of a model with irregular topography, caldera fill, and magma chamber; (3) interpretation of VSP (Vertical Seismic Profiling) data from the Oroville fault zone by ray tracing and polarization calculation for P, SV, and SH waves in heterogeneous and anisotropic media containing aligned fluid-filled and/or dry cracks; and (4) development of a new powerful method for calculating seismic motions in media with irregular topography and interfaces by the superposition of Gaussian Beams.

46333 **(PB—87-195053/XAB) Measurement and location of earthquakes in western Alaska, the Gulf of Alaska, and the Bering Sea. Final report.** Frohlich, C.; Donoho, P. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). May 1982. 46p. NTIS, PC A24/MF A01.

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 49, 85-133(Dec 1986).

The specific objective of the research were: To recover the strong motion OBS instruments deployed in the Gulf of Alaska in 1980, and deploy these and other instruments in the Gulf of Alaska and the Bering Sea; To monitor microseismic activity rates near the Amak Fault Zone and the Port Moller Graben to determine whether these features are currently active, and if so, to determine the level of activity; To apply recently developed sophisticated location methods to the earthquake data that have been collected by the University of Alaska land network.

46334 **(UCRL—53809) Institute of Geophysics and Planetary Physics at Lawrence Livermore National Laboratory: 1986 annual report.** Max, C.E. (ed.). (Lawrence Livermore National Lab., CA (USA)). 1 Jul 1987. Contract W-7405-ENG-48. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014618.

The purpose of the Institute of Geophysics and Planetary Physics (IGPP) at LLNL is to enrich the opportunities of University of California campus researchers by making available to them some of the Laboratory's unique facilities and expertise, and to broaden the scientific horizon of LLNL researchers by encouraging collaborative or interdisciplinary work with other UC scientists. The IGPP continues to emphasize three fields of research - geoscience, astrophysics, and high-pressure physics - each administered by a corresponding IGPP Research Center. Each Research Center coordinates the mini-grant work in its field, and also works with the appropriate LLNL programs and departments, which frequently can provide supplementary funding and facilities for IGPP projects. 62 refs., 18 figs., 2 tabs.

46335 **(UCRL—96157) High resolution seismic attenuation tomography at Medicine Lake Volcano, California.** Zucca, J.J.; Kasameyer, P.W. (Lawrence Livermore National Lab., CA (USA)). 10 Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-871024—14). NTIS, PC A02. File Number DE87013790.

From Annual meeting of Geothermal Resources Council; Sparks, NV, USA (12 Oct 1987).

Medicine Lake Volcano, a broad shield volcano about 50km east of Mount Shasta in northern California, produced rhylotic

eruptions as recently as 400 years ago. Because of this recent activity it is of considerable interest to producers of geothermal energy. In a joint project sponsored by the Geothermal Research Program of the USGS and the Division of Geothermal and Hydropower Division of the US-DOE, the USGS and LLNL conducted an active seismic experiment designed to explore the area beneath and around the caldera. The experiment of eight explosions detonated in a 50 km radius circle around the volcano recorded on a 11 x 15 km grid of 140 seismographs. The travel time data from the experiment have been inverted for structure and are presented elsewhere in this volume. In this paper we present the results of an inversion for 1/Q structure using t^* data in a modified Aki inversion scheme. Although the data are noisy, we find that in general attenuative zones correlate with low velocity zones. In particular, we observe a high 1/Q zone roughly in the center of the caldera at 4 km depth in between two large recent dacite flows. This zone could represent the still molten or partially molten source of the flows.

46336 **(USGS-OFR—87-80) Historical catalog of southern Great Basin earthquakes, 1868-1978.** Meremonte, M.E.; Rogers, A.M. (Geological Survey, Denver, CO (USA)). 1987. Contract AI08-78ET44802. 167p. NTIS, PC A08. File Number DE87014340.

This catalog is a collation of earthquake hypocenters, intensities, and magnitudes for the southern Great Basin (SGB) for the period 1868-1978 prior to the operation of the SGB network. The data are drawn from many sources such as earlier non-instrumental reports for the oldest earthquakes in national catalogs, reports by university stations operated in California, Nevada, and Utah, and data collected by local and regional networks that were operated temporarily in limited areas of the SGB. The geographical boundaries are 35.6°-38.5° N., 114.5°-118.0° W. This area encloses a circle of about 160 km radius centered on NTS. The catalog includes both natural and man-made earthquake activity. Man-made events include aftershocks and cavity collapses (which occur following most NTS nuclear tests), mining blasts and high-explosive experiments, and induced seismicity due to the impoundment of Lake Mead.

46337 **Determining planes along which earthquakes occur: Method of application to earthquakes accompanying hydraulic fracturing.** Fehler, M.; House, L.; Kaieda, H. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **92**: No. B9, 9407-9414(10 Aug 1987).

Although it is generally accepted that earthquakes occur along preexisting faults, the distribution of earthquake locations is often so smeared that the underlying fault or joint structures along which the earthquakes occur cannot be inferred from visual inspection of location plots. We present a statistical method for identifying fault of joint planes within what may otherwise appear to be an amorphous earthquake location set. The method takes all the hypocenters in an event set three at a time in order to determine the strikes and dips of all possible planes within the event set. A procedure for correcting for the shape of the region in which the earthquakes occur is applied. After correction, the orientation (one or a few) that is seen most often is taken as that of the zone of preexisting fault(s) of joint(s). We applied the method to a set of hypocenters determined for microearthquakes that accompanied a hydraulic injection into crystalline rock. The method was able to resolve successively five statistically significant orientations (planes) along which most of the microearthquakes occurred. The first two planes determined by the method are parallel to one nodal plane from each of the two most commonly found fault plane solutions. One of the two planes intersects the injection well bore at a location where water is known to have entered the rock during the injection. The planes identified thus coincide with the major fluid paths during the hydraulic injection. copyright American Geophysical Union 1987

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 45124, 45977, 46049, 46329, 46381

5804 Geochemistry

46338 **(LBL—23554) A thermodynamic model for aqueous solutions of liquid-like density.** Pitzer, K.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 81p. (CONF-871014—1). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014072.

From Annual meeting of the Geochemical Society; Phoenix, AZ, USA (25 Oct 1987).

The paper describes a model for the prediction of the thermodynamic properties of multicomponent aqueous solutions and discusses its applications. The model was initially developed for solutions near room temperature, but has been found to be applicable to aqueous systems up to 300°C or slightly higher. A liquid-like density and relatively small compressibility are assumed. A typical application is the prediction of the equilibrium between an aqueous phase (brine) and one or more solid phases (minerals). (ACR)

46339 **(UCRL—53642) Precipitation kinetics option for the EQ6 geochemical reaction path code.** Delany, J.M.; Puigdomenech, I.; Wolery, T.J. (Lawrence Livermore National Lab., CA (USA)). 19 May 1986. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013823.

The EQ6 reaction path code has been modified to permit the modeling of mineral growth kinetics. This modeling option complements a pre-existing capability that allows mineral dissolution kinetics to be calculated. Before this option was added, mineral precipitation in EQ6 was required to follow instantaneous saturation equilibrium. A review of the rate laws pertaining to mineral precipitation and dissolution has led to several rate laws for precipitation, paralleling those for dissolution being programmed into EQ6. Included are rate laws for transition-state theory expressions and activity-term expressions. To use the modeling option, EQ6 users must choose an appropriate rate law and provide the necessary constants for each kinetically governed reaction in the input file. Additional rate laws can be added with little difficulty. We have exercised the new capability for some relatively simple cases and partially verified it against closed-forms solutions for cases of precipitation and recrystallization of pure silica phases. This capability facilitates the extrapolation and testing of rate laws in systems where precipitation is important, including the case of mineral transformations involving coupled dissolution and precipitation. It also permits more realistic simulation modeling of relatively short-term rock/water interaction experiments and of long-term interactions that are inaccessible by experiment.

46340 **Ground water geochemistry of short-term aquifer thermal energy storage test cycles.** Holms, T.R.; Eisenreich, S.J.; Rosenberg, H.L.; Holm, N.P. (Illinois State Water Survey, Champaign). *Water Resources Research;* **23**: No. 6, 1005-1019(Jun 1987).

The changes in the concentrations of Ca, dissolved silica, and alkalinity of the recovery waters of four short-term aquifer thermal energy storage test cycles with respect to the injection waters and the correlation of these concentrations with recovery water temperatures indicate that quartz and calcite dissolved during hot water storage. This hypothesis was supported by chemical equilibrium modeling and mass balance calculations. Magnesium concentrations were lower in recovery waters than in injection waters. Chemical modeling indicated that a Mg silicate (talc) could have precipitated. Potassium concentrations correlated well with temperatures, probably because of ion exchange involving potassium feldspars in the aquifer.

5805 Oceanography

REFER ALSO TO CITATION(S) 44968, 44969, 44970, 44971, 44972, 44973, 44974, 44975

46341 **(PB—87-198917/XAB) Circulation and water masses in the Gulf of Alaska. Final report.** Royer, T.C. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Mar 1981. 131p. NTIS, PC A99/MF E04.

Included in Outer Continental Shelf Environmental Assessment Program. Final Reports of Principal Investigators, Vol. 51, 539-684(Dec 1986).

In the last year of the OCS project, analysis of prior oceanographic data from the Gulf of Alaska has continued with several new ideas and concepts evolving. In addition to the continued treatment of archived OCS data, more recent hydrographic and meteorological data gathered on other projects, are being incorporated into the analysis. For example, two cruises in Fall 1980 occupied many of the stations in the OCS grid. These additional data have provided new insights into the costal circulation in the Gulf of Alaska.

46342 **Numerical study of sea ice and ocean circulation in the Arctic.** Semtner, A.J. Jr. (National Center for Atmospheric Research, Boulder, CO 80307). *Journal of Physical Oceanography;* **17**: No. 8, 1077-1113(Aug 1987).

A sea-ice model based on bulk-viscous plastic dynamics and 3-layer thermodynamics is coupled to a multilevel primitive equation model of the Arctic Ocean and Greenland Sea. The combined model is forced by inflow through the Faeroe—Shetland Channel and Bering Strait and by observed monthly atmospheric forcing and river runoff. A long-term integration produces a realistic seasonal cycle of ice cover, whose extent is strongly influenced by ocean heat transport. The wintertime maximum is controlled by northward heat transport of 0.4 petawatts in the Greenland Sea and by southward transport of ice and water through the Fram Strait. The summertime minimum extent of sea ice is influenced by subsurface flow through the Fram Strait of warm Atlantic water, which rises in winter and thins the ice lying over the Eurasian continental shelf and along the Alaskan and Siberian coasts. The oceanic circulation in the Canadian Basin is anticyclonic at all depths, but changes to cyclonic in the Eurasian Basin below 200 meters. Offshore ice transport in the Barents Sea promotes oceanic convection on the continental shelf through enhanced brine rejection, whereas surface heat loss in the ice-free Greenland Sea produces intermediate water sources similar in T—S characteristics to observed water masses of the region. Two short additional integrations of the coupled model show that the Arctic sea ice is vulnerable to the environmental effects of atmospheric CO_2 increase, but relatively insensitive to the maximum proposed amount of Soviet river diversions.

64 PHYSICS I

REFER ALSO TO CITATION(S) 45549, 46058

46343 **Physics through the nineties.** Brinkman, W.F. (Sandia National Labs., Albuquerque, NM). *Applied Physics Communications;* **7**: No. 1-2, 81(Mar-Jun 1987).

The National Research Council has surveyed the progress of physics in the past decade and looked to the needs of the future. The survey will be reviewed and its conclusions presented and discussed.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 46334, 46400, 46403, 46525, 46526, 46582, 46615

46344 **(AD-A—181296/5/XAB) Calibration problems in solar speckle interferometry.** Luhe, O.V.D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jan 1987. 6p. (AFGL-TR—87-0178). NTIS, PC A02/MF A01.

Pub. in Interferometric Imaging in Astronomy, 9-12(12-15 Jan 1987).

Techniques were developed which allow to estimate the Speckle transfer function (STF) from the observations directly. The Welter and Worden (1978; see also Bruck and Sodin, 1980) technique relies on the perception that the STF may be approximated by the square of the short-term transfer function (Fried, 1966) plus a term proportional to the diffraction-limited transfer function. This technique is not quite satisfactory when seeing is reasonably good, because intermediate spatial frequency regions, which may contribute a significant portion to the power spectrum of solar structure, are not very well corrected. In another approach, the Fried (1966) parameter r_0 is inferred from the data and theoretical STF models such as Korff's (1974) are used to correct Fourier amplitudes. In the technique proposed by Aime et al. (1980), the ratio of the average power spectra from two sets of specklegrams is analyzed in order to obtain r_0 for both sets. This method may pose a problem when a sufficient number of specklegrams cannot be taken within the typical change time of the fine structure. Also, information at high spatial frequencies, where the signal-to-noise ratio may be low, is analyzed. In order to eliminate these problems, the author proposed to analyze the ratio of the power spectrum of the average picture and the average power spectrum instead (von der Luhe, 1984). This approach allows estimation of r_0 as well as the signal-to-noise ratio (SNR) of the speckle signal at higher frequencies. In this contribution, the author briefly describes the technique and demonstrates its performance.

46345 **(AD-A—181297/3/XAB) Working Group C report on short-term solar predictions.** Smith, J.B.; Neidig, D.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jun 1987. 6p. (AFGL-TR—87-0184). NTIS, PC A02/MF A01.

Pub. in Solar-Terrestial Predictions, 167-169(18-22 Jun 1984).

Contents include: early recognition of flares (flares precursors); proton events; daily flare forecasts; vector magnetic fields, shear (and energy storage); modeling.

46346 **(AD-A—181348/4/XAB) Application of the Knox-Thompson method to solar observations.** Luhe, O.V.D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jan 1987. 6p. (AFGL-TR—87-0177). NTIS, PC A02/MF A01.

Pub. in Interferometric Imaging in Astronomy, 37-40(12-15 Jan 1987).

The Knox-Thompson (KT) technique is well suited for speckle imaging of an extended source, such as the sun. Other techniques require that the extent of the observed object is restricted to the field size (e.g., the Fienup technique) or even to much less than the seeing disk size (e.g., shift-and-add). The Knox-Thompson technique, as well as the speckle-masking technique, are more general in that they make no assumptions about the object size. Because of its relative simplicity, the KT technique has been applied to solar data. A KT speckle-imaging program has been dedicated to solar data analysis. The program, named KISIP, now runs on the NSO/Sacramento Peak VAX 750 under 4.3 BSD UNIX. Major features of the code are: combination of the Labeyrie (1970, for Fourier-amplitude recovery) - and Knox-Thompson (phase recovery) techniques; incorporation of the spectral-ratio technique to correct Fourier amplitudes for seeing attenuation; and incorporation of a phase consistency test to estimate the accuracy to which phases can be reconstructed from Knox-Thompson bispectra.

46347 **(AD-A—181468/0/XAB) Microwave spectroscopy of a solar-active region observed during a partial eclipse. Final report, 1 January 1984-31 December 1985.** Gary, D.E.; Hurford, G.J. (California Inst. of Tech., Pasadena (USA)). Apr 1976. 26p. NTIS, PC A03/MF A01.

This work presents the first attempt at using microwave spectroscopy as a diagnostic tool for the study of complex solar-active regions. Since the relevant emission mechanisms are gyroresonance opacity and thermal bremsstrahlung (free-free), the microwave emission is expected to depend on the values of temperature, density, and magnetic fields in the solar corona.

46348 **(AD-A—181497/9/XAB) Scintillation theory of eclipse shadow bands.** Codona, J.L. (La Jolla Inst., CA (USA). Center for Studies of Nonlinear Dynamics). 1986. 14p. NTIS, PC A02/MF A01.

Pub. in Astronomy and Astrophysics, Vol. 164, 415-427(1986).

The results of a theoretical investigation of solar eclipse shadow bands are presented. The study provides both quantitative and qualitative insight into the factors governing the visibility of shadow bands. Using only standard, weak-scattering scintillation theory and standard models for atmospheric turbulence, all of the salient features of the shadow bands are explained. The contrast is found to be greater for shorter wavelengths and the band spacing to scale like the square-root of the wavelength very near totality. For times greater than about 20 seconds before (or after) totality the band spacing becomes frequency-independent and the scintillations are dominated by turbulence near the ground. The turbulence mainly responsible for shadow bands is found to be below two kilometers in altitude. Turbulence at the tropopause is found to have no impact on shadow bands until 2-3 seconds from totality. Longer eclipses are expected to show bands with greater contrast and linearity. Intensity correlation scales are typically less than 10cm within 30 seconds of totality. The scintillation theory predictions for shadow band structure motion, and evolution are found to be in agreement with both visual and photoelectric observations.

46349 **(AD-A—181541/4/XAB) Application of the blast waves in the solar wind concept to major interplanetary shocks during the Solar Maximum Year (SMY).** Smart, D.F.; Shea, M.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 7p. (AFGL-TR—87-0185). NTIS, PC A02/MF A01.

Pub. in Solar Maximum Analysis, 255-260(1986).

During the SMY there were a number of solar-flare-initiated shock events that were observed at varying radial distances from the sun. The propagation characteristics of these shock fronts can be deconvolved into two separable components. These are the shock front resulting from the impulsive release of energy from a solar flare and the pre-existing solar wind which vectorially combine to yield the disturbance speed toward the observation location. From the empirical deconvolution of the solar-flare-initiated shock into separable components, it was found that a general characteristic of the shock-front speed profile in the solar-wind frame is a slope of -0.5, the same expected for a blast wave.

46350 **(AD-A—181542/2/XAB) Study of sizes, brightnesses, and dynamics of solar facular points.** Luhe, O.V.D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jan 1987. 6p. (AFGL-TR—87-0183). NTIS, PC A02/MF A01.

Pub. in Interferometric Imaging in Astronomy, Proceedings of a Joint ESO/NOAO Workshop, Oracle, 252-228(12-13 Jan 1987).

This poster presents first results of an ongoing project to study the structure and the dynamics of small faculae. Facular points typically have angular scales smaller than one second of arc, and they are believed to represent the footpoints of magnetic flux-tubes in the solar photosphere. In the past, they have been studied using single frames or photographic time series covering periods as long as one hour. Except for Koutchmy's study, no attempt has been made to deconvolve the atmospheric-telescopic point spread function from the observation in order to obtain intensity profiles of facular points. Recent theoretical models of very small flux tubes predict the appearance of bright footpoints (i.e., facular points) in the continuum at a solar disk center having a diameter of some 300 km and a maximum brightness approximately 1.4 times the average photospheric intensity.

46351 **(AD-A—181564/6/XAB) Kilometric Type-II radiation from interplanetary shocks: interpretation of Voyager results.** Leblanc, Y.; Smart, D.F.; Shea, M.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 6p. (AFGL-TR—87-0186). NTIS, PC A02/MF A01.

Pub. in Advances in Space Research, Vol. 6, No. 1, 385-388(1986).

April 1978 was an unusually active month with five well-defined kilometric Type-II radio bursts observed by the radio-astronomy experiment on the Voyager spacecraft. An analysis was made of the kilometric radio events and their associated interplanetary shocks. The apparent speed of each of the shocks was determined from the average frequency drift rate of the kilometric type-II burst by employing the hypothesis that the radiation was emitted at the local plasma frequency. This analysis suggests that the Type-II emission emanates from local dense structures in the interplanetary medium. Sudden changes in the frequency drift rate can be explained by assuming that the shock propagates into a region with a different density gradient.

46352 **(AD-A—181714/7/XAB) Variable oblateness of the sun: measurements of 1984.** Dicke, R.H.; Kuhn, J.R.; Libbrecht, K.G. (Princeton Univ., NJ (USA). Joseph Henry Lab. of Physics). 15 Dec 1986. 9p. NTIS, PC A02/MF A01.

Pub. in The Astrophysical Jnl., Vol. 311, No. 2, 1025-1030(15 Dec 1986).

The solar oblateness measured in 1984 appears to be significantly less than the 1983 value. This is in turn substantially less than the 1966 value. The observations of 1983 and 1984 were made with a modified and improved version of the Princeton Solar Distortion Telescope used in 1966. Its design is discussed. The source of error and the analysis technique are discussed. The observed changes in oblateness of the Sun are believed to be real and significant.

46353 **(AD-A—181729/5/XAB) Imaging of coronal mass ejections by the HELIOS spacecraft.** Jackson, B.V. (California Univ., San Diego (USA)). 1985. 13p. NTIS, PC A02/MF A01.

Pub. in Solar Physics, Vol. 100, 563-574(1985).

The zodiacal light photometers on board the HELIOS spacecraft can be used to form images of coronal mass ejections in the interplanetary medium. Several aspects of these data are unique: they trace coronal mass ejections using Thomson-scattering techniques to distances from the Sun greater than 0.5 AU; their perspective from the HELIOS orbits allows information to be gained about the three-dimensional shapes of specific mass ejections viewed both by coronagraphs and HELIOS; the global view afforded by the spacecrafts photometers can image the mass ejection from within and thus relate in-situ measurements to the shape of the whole structure. To date, the HELIOS photometers have been used to study coronagraph-observed mass ejections including those that originated at the Sun on 7 May, 24 May, and 27 November, 1979, and 21 May, 18 June, 29 June, and 6 November, 1980. Masses of ejections determined from these data are generally a few times larger than masses determined from SOLWIND coronagraph images.

46354 **(AD-A—181771/7/XAB) Changes in the microturbulence spectrum of the solar wind during high-speed streams.** Coles, W.A.; Filice, J.P. (California Univ., San Diego, La Jolla (USA). Dept. of Electrical Engineering and Computer Sciences). 1 Jun 1985. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 90, No. A6, 5082-5088(1 Jun 1985).

Interplanetary scintillation (IPS) observations are used to investigate the distribution of microscale density fluctuations in high-speed solar-wind streams. A new technique for estimating the electron-density power spectrum that can be applied when the solar wind is grossly inhomogeneous is presented. This technique requires accurate knowledge of the radio-source structure, in-situ measurements of the solar-wind velocity, and well-calibrated IPS observations. The estimation algorithm is applied to data obtained during 1973 and 1974 when the solar wind was dominated by recurrent fast streams. It is found that the spectrum has a power low exponent alpha approx. = 3.2 in the decreasing and low-velocity regions of streams. The spectrum steepens and it's levels increase in the regions of enhanced density that precede such streams, and it remains steep into the high-velocity regions. The average exponent in these regions is alpha approx. = 4.1. The average density spectrum obtained from this analysis is consistent with estimates of the spectrum obtained via other techniques.

46355 (ESA-SP—250-VOL-1, pp vp) **Observations of heavy energetic ions far upstream from Comet Halley.** Sanderson, T.R.; Wenzel, K.P.; Daly, P.W.; Cowley, S.W.H.; Hynds, R.J.; Richardson, I.G.; Smith, E.J.; Bame, S.J.; Zwickl, R.D. (Los Alamos Scientific Lab., NM). Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

On March 25, 1986, when the ICE spacecraft came within 28 million km of the nucleus of comet Halley, and for several days around this time, bursts of heavy ions were observed by the ICE energetic ion experiment. The bursts were observed only during periods when the solar wind velocity was considerably higher than its nominal value. The characteristics of these ions, in particular their anisotropies, were examined. Using the well known formulae for transformation of distributions from the solar wind frame of reference to the spacecraft frame, the angular distributions expected from either protons, or heavy ions from the water group, were studied, showing that the measurements are consistent with heavy ions, and not with protons. Other sources of heavy ions are considered, and the most likely source of these ions is comet Halley.

46356 (ESA-SP—250-VOL-1, pp vp) **Upstream region, foreshock and bow shock wave at Halley's Comet from plasma electron measurements.** Anderson, K.A.; Carlson, C.W.; Curtis, D.W.; Lin, R.P.; Reme, H.; Sauvaud, J.A.; Duston, C.; Korth, A.; Richter, A.K.; Mendis, D.A. (California Univ., San Diego). Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

Halley plasma electron parameters from 2.7 million km from the comet nucleus to the bow shock wave at 1.1 million km and beyond are surveyed. The features of the electron foreshock lying outside the shock to a distance of 230,000 km are described. It is a region of intense solar wind-comet plasma interaction in which energetic electrons are prominent. Several spikes of electrons whose energies extend to 2.5 keV appear in front of the shock. These energetic electrons may be accelerated in the same way electrons are accelerated at the Earth's bow shock to energies of 1 to 10 keV. The direction of the electron bulk flow direction changes abruptly between 1920 and 1922 UT, and the flow speed begins a sharp decline at the same time. It is suggested that the spacecraft entered the bow shock wave between 1920 and 1922 UT. Electron density variations at Halley are very much smaller than those at Giacobini-Zinner.

46357 (ESA-SP—250-VOL-1, pp vp) **Detection of OH from Comet Halley in the far-infrared.** Stacey, G.J.; Lugten, J.B.; Genzel, R. (Max-Planck-Inst. fuer Physik und Astrophysik, Garching, West Germany). Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

The 2 Pi 3/2 (J = 5/2 yields 3/2 + yields - parity) transition of OH was detected in comet Halley at 119.44 microns. The upper limit to the line intensity of the - yields + parity transition is 119.23 microns. The ratio of these lines is consistent with radiative pumping of the rotational levels through absorption of near ultraviolet solar photons which excite the low lying vibrational levels of OH. The far-infrared lines probe the inner regions of the coma where OH is produced through photodissociation of a parent molecule (presumably H_2O). Hence, these lines complement the 18 cm radio measurements which are sensitive to the outer regions of the comet coma. The OH production rate is highly model dependent but is of the order 2 to 4 times 10 to the 29th power molecules/sec.

46358 (ESA-SP—250-VOL-1, pp vp) **VLA observations of Comet Halley: the brightness distribution of OH around the comet.** Depater, I.; Palmer, P.; Snyder, L.E.; Ip, W.H. (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany). Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

Very Large Array imaging of OH around Halley's comet is summarized. The emission seems concentrated in clumps, which surround a hole at the center. The hole is likely due to a quenching of the OH maser.

46359 (ESA-SP—250-VOL-1, pp vp) **Oxygen production rates for P/Halley over much of the 1985-1986 apparition.** Spinrad, H.; Mccarthy, P.J.; Strauss, M.A. Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

Long slit CCD spectrophotometry of comet P/Halley in the visible region was used to measure the production rate of atomic oxygen during the 1985/86 apparition. The observations cover a large range of heliocentric distances, since the technique is applicable to apparently bright and faint comets. The cometary gas production rate for P/Halley increases rapidly with decreasing heliocentric distance toward perihelion and is systematicaly larger at a given heliocentric distance for the postperihelion observations. The average production rate for O1D on the day of the Giotto flyby is 4 times 10 to the 28th power atoms/sec giving an extrapolated total water production rate of 6 times 10 to the 29th power mols/sec. A method for comparing the absolute cometary gas production rates for different comets is discussed.

46360 (ESA-SP—250-VOL-1, pp vp) **Comet P/Giacobini-Zinner electron and H_2O column densities from ICE and ground-based observations.** Meyer-vernet, N.; Strauss, M.A.; Steinberg, J.L.; Spinrad, H.; Mccarthy, P.J. (California Univ., Berkeley). Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

An $H_2O(+)$ emission profile extracted from an optical CCD spectrogram obtained during the ICE/Giacobini-Zinner encounter is compared to the electron density profile deduced from in-situ measurements by the ratio experiment aboard ICE. It is concluded that the electrons and the $H_2O(+)$ ions are distributed similarly 9600 km tailward from the cometary nucleus; that the ratio of number densities of $H_2O(+)$ ions to electrons is 1/4 at this point; and that the width of the plasma sheet is 16,000 km.

46361 (ESA-SP—250-VOL-1, pp vp) **Model ion abundances for Comet Halley.** Huebner, W.F.; Boice, D.C.; Keady, J.J.; Schmidt, H.U.; Wegman, R. (Max-Planck-Institute fuer Astrophysik, Garching, West Germany). Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

A computer model for comet comae was applied to predict ion abundances for comet Halley, assuming that the volatile component of the nucleus is 85% water and that the remaining volatile molecules are composed of carbon, nitrogen, oxygen, and sulfur. Model parameters such as heliocentric distance, size, and albedo are chosen to be consistent with the 13 to 14 March 1986 encounter of Giotto with the comet. Photoprocesses, gas-phase chemical kinetics, coma energy balance including a separate electron temperature, multifluid hydrodynamics with a transition to free molecular flow, fast streaming atomic and molecular hydrogen, and counter and cross streaming of species in the coma-solar wind interaction are taken into consideration. A comparison of the model results with data from the ion mass spectrometer at 6000 and 1500 km from the

nucleus shows good agreement. Implications of the coma physics and chemistry are discussed.

46362 (ESA-SP—250-VOL-1, pp vp) **Comparison of the high resolution IUE observations of CS emission in Comets Halley and Giacobini-Zinner.** Jackson, W.M.; Prisant, M.G. (California Univ., Berkeley). Dec 1986. NTIS, PC A99/MF A01; print copy avail. from EPD, ESTEC, Noordwijk, The Netherlands Dfl 175 (3 volumes). (ETN—87-99858).

In Proceedings of the 20th ESLAB Symposium on the Exploration of Halley's Comet. Volume 1: Plasma and Gas.

The high resolution spectra of comets Giacobini-Zinner and Halley were measured in the region of the CS emission. Both spectra have essentially the same shape, but the Halley spectrum has a better signal to noise ratio. The rotational distribution of the radical in these comets was derived by using an inversion program and spectral simulation. Both procedures suggest that the rotational distribution is dominated by CS radical with J″ is less than or = 5. Despite this it appears that another distribution with higher J″ is needed to explain the shape of the rotational distribution. It is suggested that this second distribution is due to a balance between collisions and radiation in the inner coma.

46363 **(FNAL/C—86/146-A) Particle physics and cosmology.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1986. Contract AC02-76CH03000. 56p. (CONF-8606259—3). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87005400.

From Theoretical Advanced Study Institute conference; Santa Cruz, CA, USA (23 Jun 1986).

This series of lectures is about the role of particle physics in physical processes that occurred in the very early stages of the bug gang. Of particular interest is the role of particle physics in determining the evolution of the early Universe, and the effect of particle physics on the present structure of the Universe. The use of the big bang as a laboratory for placing limits on new particle physics theories will also be discussed. Section 1 reviews the standard cosmology, including primordial nucleosynthesis. Section 2 reviews the decoupling of weakly interacting particles in the early Universe, and discusses neutrino cosmology and the resulting limits that may be placed on the mass and lifetime of massive neutrinos. Section 3 discusses the evolution of the vacuum through phase transitions in the early Universe and the formation of topological defects in the transitions. Section 4 covers recent work on the generation of the baryon asymmetry by baryon-number violating reactions in Grand Unified Theories, and mentions some recent work on baryon number violation effects at the electroweak transition. Section 5 is devoted to theories of cosmic inflation. Finally, Section 6 is a discussion of the role of extra spatial dimensions in the evolution of the early Universe. 78 refs., 32 figs., 6 tabs.

46364 **(IC—86/355) On the degree of generality of inflationary solutions in cosmological models with a scalar field.** Belinsky, V.A.; Khalatnikov, I.M. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87703079.

Homogeneous cosmological models of Bianchi I and Friedmann type in the presence of the massive scalar field are studied. Using qualitative theory of dynamical systems we show that the majority of solutions undergoes the inflationary stage. This study is the direct continuation of a previous paper. 4 refs, 7 figs.

46365 **(IC—86/357) Crucial cosmological observations.** Lukash, V.N.; Novikov, I.D. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703081.

A current problem of determining the fundamental constants of the Universe - H/sub O/, q/sub O/, Ω, Λ, hidden matter and primordial perturbation parameters - is considered. New evidence for the large-scale ΔT/T-fluctuations to be found in the near future are discussed. 30 refs, 2 tabs.

46366 **(IC—86/391) Might dark matter not be concentric with luminous matter.** Xu Chongming; Lu Tan. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703094.

In this paper, an idea on dark matter nonconcentric with luminous matter is proposed. This case could influence the rotation curve of galaxy differently in its different direction. Recently, Rubin and Ford's observation on rotation curve of Hickson 88a has been explained by means of the idea. Some possible observational predictions have also been given. 8 refs, 4 figs.

46367 **(LA—11005) High explosive simulations of supernovae and the supernova shell fragmentation model of solar system formation.** Brown, W.K. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014708.

Comparison of photographs of explosive experiments to the Casseopeia A supernova remnant reveals a striking similarity. The similarity could indicate the presence of a relatively cool, underlying shell in the Casseopeia A remnant. As this shell expands and fragments, the observable features are produced by hot gases squirting through the cracks - as in explosive experiments. The existence of such underlying shells in supernova remnants supports the author's model of solar system formation.

46368 **(N—87-24157) Radiation transport in dust in disk geometry. Final technical report, 15 April 1984-16 October 1986.** Chun, M.L. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Oct 1986. 9p. (NASA-CR—180995; NAS—1.26:180995). NTIS, PC A02/MF A01.

The main objective of the research program is twofold: (1) to develop a computer code to solve the problem of scattering, absorption and emission of photons by dust grains in a dusty medium with 2 dimensional disk geometry, and (2) to study the various physical and geometrical effects of 2 dimensional radiation transport on the thermal structure and radiation field. These tasks were accomplished and are briefly summarized. The method for solving the radiation transport problem in disk geometry is a generalization of the quasi-diffusion method (QDM) previously developed by the author.

46369 **(N—87-24166) Joint NASA/Goddard-University of Maryland research program in charged particle and high energy photon detector technology. Semiannual progress report, September 1986-March 1987.** (Maryland Univ., College Park (USA)). Jun 1987. 13p. (NASA-CR—180996; NAS—1.26:180996). NTIS, PC A02/MF A01.

The first measurements of Fe charge states in two coronal hole-association high speed streams, using the sensor on ISEE-3, are presented. Eight ‹vent intervals from the January to June 1983 timeframe were chosen for the study of magnetotail dynamics and its relationship to substorm activity and the possible formation of plasmoids. Techniques are being explored for measurement of secondary electrons which are characteristically emitted when ions hit a target material. Efforts are continuing to understand kilometer wavelength shock associated radio events. An all-sky survey of fast x-ray transients of duration of 5 to 10,000 s was completed. Research using high resolution gamma-ray spectroscopy of celestial sources in the 20 keV to 20 MeV range to search for and study narrow lines in low-energy gamma-ray spectrum continues. Research in high energy radiation from pulsars is being conducted.

46370 **(N—87-24387) Physics of the inner heliosphere: Mechanisms, models and observational signatures. Semiannual progress reports, 1 May 1986-30 April 1987.** Withbroe, G.L. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Jun 1987. 22p. (NASA-CR—181063; NAS—1.26:181063; SAPR—10; SAPR—11). NTIS, PC A02/MF A01.

Selected problems concerned with the important physical processes that occur in the corona and solar wind acceleration region, particularly time dependent phenomena were studied. Both the physics of the phenomena and the resultant effects on observa-

tional signatures, particularly spectroscopic signatures were also studied. Phenomena under study include: wave motions, particularly Alfven and fast mode waves; the formation of standing shocks in the inner heliosphere as a result of momentum and/or heat addition to the wind; and coronal transient phenomena where momentum and/or heat are deposited in the corona to produce transient plasma heating and/or mass ejection. The development of theoretical models for the inner heliosphere, the theoretical investigation of spectroscopic plasma diagnostics for this region, and the analysis of existing skylab and other relevant data are also included.

46371 **(N—87-24977) Possible complementary cosmic-ray systems: nuclei and antinuclei.** Buck, W.W.; Wilson, J.W.; Townsend, L.W.; Norbury, J.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1987. 47p. (NASA-TP—2741; L—16275; NAS—1.60:2741). NTIS, PC A03/MF A01.

Arguments are presented for the possible existence of antinuclei of charge absolute value of Z greater than 2 and particularly galactic cosmic antinuclei. Theoretical antinucleus-nucleus optical model cross sections are calculated and presented for the first time. A brief review of the nucleon-antinucleon interaction is also presented and its connection with the antinucleus-nucleus interaction is made. The predicted cross sections are smooth and show no structure. Finally, the findings are tied together with the formation of microlesions in living tissue.

46372 **(N—87-25103) Far infrared observations of crab-like supernova remnants. Final report, 1 June 1985-31 May 1986.** Helfand, D.J.; Becker, R.H. (Columbia Univ., New York (USA)). Jul 1986. 6p. (NASA-CR—181081; JPL—9950-1299; NAS—1.26:181081; CAL—1615). NTIS, PC A02/MF A01.

Using the Infrared Astronomy Satellite (IRAS) data, an investigation was begun of the far infrared properties of Crab-like supernova remnants and other synchrotron nebulae. Both the co-added scanning data and, where available, pointed observations were examined. To date infrared emission was found from two Crab-like remnants: G24.7+0.6 in which the infrared source near the center of the object was shown to be a compact HII region with EM greater than or approximately 10 to the 7th pc/cm(6); and G0.9+0.1, where a marginal detection of a 25 micron source coincident with the remnant core was used to set limits on the energetics of this synchrotron nebula. Further work, in progress under a second year of this program, should yield additional information concerning the distribution of initial pulsar spin periods and the evolution of synchrotron nebulae.

46373 **(N—87-25139) Stream structures in the outer heliosphere. Final report.** Whang, Y.C. (Catholic Univ. of America, Washington, DC). Jul 1987. 25p. (NASA-CR—180429; NAS—1.26:180429). NTIS, PC A02/MF A01.

Nineteen magnetic clouds are identified in the years from 1978 through 1982 and studied by the superimposed epoch method. The magnetic fluctuations, density, and temperature are enhanced ahead of the clouds preceded by shocks. Strong magnetic field intensities and low proton temperatures are observed in the clouds. A relatively large (2.5%) decrease in cosmic ray intensity is caused by the turbulent sheath behind an interplanetary shock ahead of a magnetic cloud. Only a small (0.5%) decrease in intensity is associated with the magnetic cloud itself. Magnetic clouds can produce geomagnetic activity with a decrease in the Dst index of the order of 100 gammas. The magnitude of the change in Dst index for the case when southward fields arrive first is comparable to that for the case of northward fields first, and the phase is such that geomagnetic activity is associated with the southward fields.

46374 **(N—87-25255) Advances in planetary geology.** (National Aeronautics and Space Administration, Washington, DC (USA)). Jun 1987. 437p. (NASA-TM—89871; NAS—1.15:89871). NTIS, PC A19/MF A01.

The surface of Mars displays a broad range of channel and valley features. There is as great a range in morphology as in scale. Some of the features of Martian geography are examined. Geomorphic mapping, crater counts on selected surfaces, and a detailed study of drainage basins are used to trace the geologic evolution of the Margaritifer Sinus Quandrangle. The layered deposits in the Valles Marineris are described in detail and the geologic processes that could have led to their formation are analyzed.

46375 (N—87-25255, pp vp) **Part 1: the geomorphic evolution of Eastern Margaritifer Sinus, Mars.** Grant, J.A. III. Jun 1987. NTIS, PC A19/MF A01. (NASA-TM—89871; NAS—1.15:89871).

In Part 1: the geomorphic evolution of Eastern Margaritifer Sinus, Mars.

Geomorphic mapping, crater counts on selected surfaces, and a detailed study of drainage basins, were used to trace the geologic evolution of Margaritifer Sinus Quandrangle. The oldest dated surface covering these basins evolved during the period of intense bombardment. Since that time four resurfacing events have occurred. The first three were all of regional extent, while the fourth, occurred locally, filling basins. Valley networks, incised in the third event unit, are always buried by the fourth event unit when present. A peak in geomorphic activity occurred from 10,000 to 5000. Events during this period included the formation of Uzboi/Ladon Valles with deposition in Ladon Basin, and the formation of Samara and Parana/Loire Valles in MC19SE. Flow out of Ladon Basin and to a lesser extent Samara and Parana/Loire Valles created etched terrain at their confluence that was synchronous with initiation of Margaritifer and Iani Chaos. The range of dates for the chaos may be due to periodic collapse. The extensive, well integrted nature of Samara and Parana/Loire Valles requires the existence of a long period of favorable climatic conditions to allow their formation. Development of these two systems was probably through sapping processes.

46376 (N—87-25255, pp 175) **Part 2: Sedimentary geology of the Valles, Marineris, Mars and Antarctic dry valley lakes.** Nedell, S.S. Jun 1987. NTIS, PC A19/MF A01. (NASA-TM—89871; NAS—1.15:89871).

In Part 2: Sedimentary geology of the Valles, Marineris, Mars and Antarctic dry valley lakes.

Detailed mapping of the layered deposits in the Valles Marineris, Mars from high-resolution Viking orbiter images revealed that they from plateaus of rhythmically layered material whose bases are in the lowest elevations of the canyon floors, and whose tops are within a few hundred meters in elevation of the surrounding plateaus. Four hypotheses for the origin of the layered deposits were considered: that they are eolian deposits; that they are remnants of the same material as the canyon walls; that they are explosive volcanic deposits; or that they were deposited in standing bodies of water. There are serious morphologic objections to each of the first three. The deposition of the layered deposits in standing bodies of water best explains their lateral continuity, horizontality, great thickness, rhythmic nature, and stratigraphic relationships with other units within the canyons. The Martian climatic history indicated that any ancient lakes were ice covered. Two methods for transporting sediment through a cover of ice on a martian lake appear to be feasible. Based on the presently available data, along with the theoretical calculations presented, it appears most likely that the layered deposits in the Valles Marineris were laid down in standing bodies of water.

46377 **(N—87-25258) Investigation of lunar crustal structure and isostasy. Final technical report.** Thurber, C.H. (State Univ. of New York, Stony Brook (USA)). Jul 1987. 12p. (NASA-CR—181071; NAS—1.26:181071). NTIS, PC A02/MF A01.

The lunar mascon basins have strongly free air gravity anomalies, generally exceeding 100 milligals at an elevation of 100 km. The source of the anomalies is a combination of mantle uplift beneath the impact basins and subsequent infilling by high-density mare basalts. The relative contribution of these two components is still somewhat uncertain, although it is generally accepted that the amount of mantle uplift greatly exceeds the thickness of the basalts. Extensive studies have been carried out of the crustal structure of mare basins, based on gravity data, and their tectonic evolution, based on compressive and extensional tectonic features. The present study endeavored to develop a unified, self-consistent model of the lunar crust and lithosphere incorporating both gravity and tectonic constraints.

46378 **(N—87-25259) Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres. Semiannual status report, 1 February-31 July 1987.** Steffes, P.G. (Georgia Inst. of Tech., Atlanta (USA)). Jul 1987. 39p. (NASA-CR—180653; NAS—1.26:180653; SASR—7). NTIS, PC A03/MF A01.

Laboratory measurements were conducted to evaluate properties of atmospheric gases under simulated conditions for the outer planets. A significant addition to this effort was the capability to make such measurements at millimeter wavelengths. Measurements should soon be completed on the millimeter wave absorption from ammonia under Jovian conditions. Also studied will be the feasibility of measuring the microwave and millimeter wave properties of phosphine (PH_3) under simulated Jovian conditions. Further analysis and application of the laboratory results to microwave and millimeter wave absorption data for the outer planet, such as Voyager Radio Occultation experiments, will be pursued.

46379 **(N—87-25261) Simulation of January 1-7, 1978 events.** Chao, J.K.; Moldwin, M.B.; Akasofu, S.I. (National Central Univ., Chung li (Taiwan)). Jun 1987. 21p. (NASA-CR—181069; NAS—1.26:181069). NTIS, PC A02/MF A01.

The solar wind disturbances of January 1 to 7, 1978 are reconstructed by a modeling method. First, the interplanetary magnetic field (IMF) background pattern, including a corotating shock, is reproduced using the Stanford source surface map. Then, two solar flares with their onset times on January 1, 0717 UT at S17 deg E10 deg and 2147 UT S17 deg E32 deg, respectively, are selected to generate two interplanetary transient shocks. It is shown that these two shocks interacted with the corotating shock, resulting in a series of interplanetary events observed by four spacecraft, Helios 1 and 2, IMP-8 (Interplanetary Monitoring Platform 8), and Voyager 2. Results show that these three shock waves interact and coalesce in interplanetary space such that Helios 2 and Voyager 2 observed only one shock and Helios 1 and IMP-8 observed two shocks. All shocks observed by the four spacecraft, except the corotating shock at Helios 1, are either a transient shock or a shock which is formed from coalescing of the transient shocks with the corotating shock. The method is useful in reconstructing a very complicated chain of interplanetary events observed by a number of spacecraft.

46380 **(N—87-25264) Cosmic X-ray physics. Semiannual status report, 1 January-30 June 1987.** Mccammon, D.; Cox, D.P.; Kraushaar, W.L.; Sanders, W.T. (Wisconsin Univ., Madison (USA)). Jul 1987. 10p. (NASA-CR—181077; NAS—1.26:181077). NTIS, PC A02/MF A01.

The soft x-ray sky survey data are combined with the results from the UXT sounding rocket payload. Very strong constraints can then be placed on models of the origin of the soft diffuse background. Additional observational constraints force more complicated and realistic models. Significant progress was made in the extraction of more detailed spectral information from the UXT data set. Work was begun on a second generation proportional counter response model. The first flight of the sounding rocket will have a collimator to study the diffuse background.

46381 **(SAND—87-0954C) Shock-chemistry in natural materials and evolution of planetary surfaces.** Boslough, M.B.; Cygan, R.T.; Venturini, E.L.; Morosin, B.; Williamson, D.L. (Sandia National Labs., Albuquerque, NM (USA); Colorado School of Mines, Golden (USA). Dept. of Physics). 1987. Contract AC04-76DP00789. 14p. (CONF-870753—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012737.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

There are two possible types of chemical reactions that can take place due to shock-loading of a mineral. The first type is one that takes place on a longer time scale than the shock event, and is due to "shock activation" of the mineral, i.e., the increase in specific free energy due to increased densities of defects and dislocations. An example of this type was experimentally studied by measuring shock-enhanced dissolution rates of three silicate minerals. The second type is the reaction that occurs immediately, or upon release to ambient pressure, and is due to the large increase in internal energy provided by the shock, together with the shift in chemical equilibrium brought about by the increased pressure and temperature. The clay mineral nontronite was the subject of an experimental study of such reactions. Both processes can affect planetary surfaces, either independently or together. The two processes, acting in synergy, are invoked to explain the composition, mineralogy, color, and physical properties of the Martian soil.

46382 **(UCRL—95413) Non-thermal AGN models.** Band, D.L. (Lawrence Livermore National Lab., CA (USA)). 1 Dec 1986. Contract W-7405-ENG-48. 5p. (CONF-8610325—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013563.

From Workshop on super massive blackholes; Fairfax, VA, USA (14 Oct 1986).

The infrared, optical and x-ray continua from radio quiet active galactic nuclei (AGN) are explained by a compact non-thermal source surrounding a thermal ultraviolet emitter, presumably the accretion disk around a supermassive black hole. The ultraviolet source is observed as the "big blue bump." The flat ($\alpha \simeq .7$) hard x-ray spectrum results from the scattering of thermal ultraviolet photons by the flat, low energy end of an electron distribution "broken" by Compton losses; the infrared through soft x-ray continuum is the synchrotron radiation of the steep, high energy end of the electron distribution. Quantitative fits to specific AGN result in models which satisfy the variability constraints but require electron (re)acceleration throughout the source. 11 refs., 1 fig.

46383 **Can bulk viscosity drive inflation?.** Pacher, T.; Stein-Schabes, J.A.; Turner, M.S. (Institut fuer Theoretische Physik der Universitaet Heidelberg, D-6900 Heidelberg, Philosophenweg 16, West Germany). *Physical Review [Section] D: Particles and Fields;* **36**: No. 6, 1603-1606(15 Sep 1987).

Contrary to other claims, we argue that bulk viscosity associated with the interactions of non- relativistic particles with relativistic particles around the time of the grand unified theory (GUT) phase transition cannot lead to inflation. Simply put, the key ingredient for inflation, negative pressure, cannot arise due to the bulk-viscosity effects of a weakly interacting mixture of relativistic and nonrelativistic particles.

46384 **Type II supernovae from prompt explosions.** Baron, E.; Bethe, H.A.; Brown, G.E.; Cooperstein, J.; Kahana, S. (Steward Observatory, University of Arizona, Tucson, Arizona 85721). *Physical Review Letters;* **59**: No. 6, 736-739(10 Aug 1987).

Evidence is cited that supernova 1987A involved a large explosion energy, ≅(2—3) x 10/sup 51/ ergs. Such a large explosion energy has not come from delayed shocks to date, nor is it likely to. Improved physics in the presupernova evolution, especially the inclusion of Coulomb interactions, has brought the iron-core mass down by approx. >0.1M/sub sun/ in the 13M/sub sun/ star which has recently been evolved. We find that supernova explosion energies up to 3 x 10/sup 51/ ergs can be obtained by the prompt-explosion mechanism, provided that a somewhat soft equation of state is used at supranuclear densities.

46385 **Bidirectional solar wind electron heat flux events.** Gosling, J.T.; Baker, D.N.; Bame, S.J.; Feldman, W.C.; Zwickl, R.D.; Smith, E.J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico). *Journal of Geophysical Research;* **92**: No. A8, 8519-8535(1 Aug 1987).

Normally the approx. >80-eV electrons which carry the solar wind electron heat flux are collimated along the interplanetary magnetic field (IMF) in the direction pointing outward away from the sun. Occasionally, however, collimated fluxes of approx. >80-eV electrons are observed traveling both parallel and antiparallel to the IMF. Here we present the results of a survey of such bidirectional electron heat flux events as observed with the plasma and magnetic field experiments aboard ISEE 3 at times when the spacecraft was not magnetically connected to the earth's bow shock. The onset of a bidirectional electron heat flux at ISEE 3

usually signals spacecraft entry into a distinct solar wind plasma and field entity, most often characterized by anomalously low proton and electron temperatures, a strong, smoothly varying magnetic field, a low plasma beta, and a high total pressure. Significant field rotations often occur at the beginning and/or end of bidirectional heat flux events, and, at times, the large field rotations characteristic of "magnetic clouds" are present. Approximately half of all bidirectional heat flux events are associated with and follow interplanetary shocks, while the other events have no obvious shock associations.

46386 **An upper limit on the flux of extraterrestrial neutrinos.** Svoboda, R.C.; Bionta, R.M.; Blewitt, G.; Bratton, C.B.; Casper, D.; Claus, R.; Cortez, B.G.; Errede, S.; Foster, G.W.; Gajewski, W. (IMB Collaboration, Fairport, OH). pp 1309-1311 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The flux of upward-going muons with energy > 2 GeV is measured as consistent with that expected from atmospheric neutrino interactions. Using a list of known x-ray and gamma-ray sources, the number of upward-going muon tracks arriving within an angular circle about each source is compared with the number of tracks expected. The authors summarize that no evidence for a significant excess is found.

46387 **Strongly interacting particles from Cygnus X-3.** Collins, J.; Olness, F. (Dept. of Physics, Illinois Institute of Technology, Chicago, IL 60616). pp 1325-1327 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

This report argues that the underground muons associated with Cygnus X-3 are caused by scattering of strongly interacting neutral particles of energy not much more than 1 TeV. The authors consider the possibility that these particles are either ordinary neutrinos or a totally new particle, both with a natural interaction mass scale of order 10-50 GeV.

46388 **Dark matter in the universe.** Silk, J. (Dept. of Astronomy, Univ. of California, Berkeley, CA 94720). pp 465-469 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Most of the universe has hitherto been invisible. It consists of dark matter in some weakly interacting form. This paper addresses the following issues; what is the nature of the dark matter? How do we infer its presence? And how can we hope to detect it? Candidates for the dark matter span about 80 orders of magnitude in mass. From 10/sup -14/ to 10/sup 19/ GeV is in the realm of particle physics, and from above 10/sup 19/ GeV to 10/sup 66/ GeV or larger belongs to astrophysics. The astrophysical candidates, which range from very large dust grains to supermassive black holes may or may not exist, and even if they are produced somewhere in the universe, we have enormous freedom in speculating about their abundance. The author is concerned with the particle physics candidates in this review. While their existence remains similarly uncertain, if they do exist, we shall see that the implications for cosmology can be very specific. Some of the more exotic particle physics candidates weight in around the Planck mass, but the generic candidates are generally in the range 1-10 GeV. He is primarily concerned with weakly interacting stable massive particles, including as a favored candidate the lightest SUSY particle. Two important exceptions are the light (— 30 eV) neutrino and the invisible axion (— 10/sup -5/ eV).

46389 **Constraints on unstable dark matter.** Flores, R.A. (Dept. of Physics, Brandeis Univ., Waltham, MA 02254). pp 470-474 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author briefly reviews the motivation for cosmologies with unstable dark matter (DM) and the various astrophysical constraints on its decay time scale. He describes an analytic model, extensively checked by numerical simulations, the allows one to compute rotation curves for disk galaxies, assuming they have formed by dissipative collapse inside a dissipationless DM halo, a fraction of which subsequently decays; one finds that flat rotation curves like those of spiral galaxies can arise only if the fraction of decaying DM does not exceed 50%. This constraint implies that a relativistic, weakly interacting decay product cannot be dominant at present, and it also sets interesting constraints on the possibility that the universe has entered a second matter-dominated era only recently.

46390 **Inflation and other cosmological aspects of superstring inspired models.** Gaillard, M.K. (Lawrence Berkeley Lab. and Dept. of Physics, Univ. of California, Berkeley, CA 94720). pp 485-492 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00098.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Investigations of the possibilities for inflation using the four dimensional models inspired by superstring theory is reported and discussed in the context of related work.

46391 **Monopoles, cosmology, and astrophysics - Update 1985.** Turner, M.S. *Annals of the New York Academy of Sciences;* 639-651(Mar 1986). (CONF-850146—).

From Aspen winter physics conference; Aspen, CO, USA (14 Jan 1985).

The characteristics of the superheavy magnetic monopoles (MMs) predicted by GUTs are reviewed, and recent developments in astrophysical MM search techniques are surveyed. Theoretical models of the birth, current distribution, and motion of MMs are examined; the observational implications of MM mass, magnetic charge, and ability to catalyze nucleon decay are considered; estimates of the average and local flux limits for MMs of 10 to the 25th eV are given (less than about 3 x 10 to the -15th and less than about 3 x 10 to the -11th/sq cm sr sec, respectively); and the possibility of detecting MMs in the sun (if they can escape annihilation there) is discussed. 54 references.

46392 **Los Alamos National Laboratory.** *American Astronomical Society, Bulletin;* **17**: No. 1, 245-258(1985).

This review covers astrophysics research done at Los Alamos National Laboratory during the period July 1, 1983 - June 30, 1984. The research areas discussed are as follows: solar system research; stellar and galactic research; and cosmology and the early universe. 93 references.

46393 **Observatory reports.** *American Astronomical Society, Bulletin;* **17**: No. 1, 237-244(1985).

Presently, Lawrence Livermore Laboratory has roughly 20 scientists engaged in astrophysics research. Areas of research are stellar evolution, supernovae, and gravitational collapse; stellar atmospheres and stellar winds; interstellar space and star formation; active galaxies and radio jets; high energy astrophysics; cosmology; and archeo-astronomy and solar system physics.

46394 **Observatory report.** Tarter, C.B. (Lawrence Livermore National Lab., CA). *American Astronomical Society, Bulletin;* **16**: No. 1, 182-185(1984). Contract W-7405-ENG-48.

This review covers research done at Lawrence Livermore National Laboratory in the fields of astronomy and astrophysics. The research areas mentioned are as follows: star evolution, supernovae, and nucleosynthesis; stellar atmospheres and winds; galaxies and the interstellar medium; and high-energy astrophysics.

46395 **Observatory report.** Stokes, R.A. (Pacific Northwest Labs., Richland, WA). *American Astronomical Society, Bulletin;* **15**: No. 1, 34-35(1983).

This review covers research at Rattlesnake Mountain Observatory in the areas of astronomy and atmospheric sciences. Research in astronomy covers extragalactic radio astronomy and optical astronomy.

46396 **Observatory reports.** Tarter, C.B. (Lawrence Livermore National Lab., CA). *American Astronomical Society, Bulletin;* **15**: No. 1, 264-268(1983). Contract W-7405-ENG-48.

This review covers research done at Lawrence Livermore National Laboratory under DOE contract. Areas of research are as follows: star evolution supernovae, and nucleosynthesis; stellar atmospheres and winds; galaxies and interstellar space; and high-energy astrophysics.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 46348, 46349, 46351, 46487

46397 **(AD-A—181302/1/XAB) Simultaneous multi-spectral narrow-band auroral imagery from space (1150A to 6300A2).** Schenkel, F.W.; Ogorzalek, B.S.; Gardner, R.R.; Hutchins, R.A.; Huffman, R.E. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 16p. (AFGL-TR—87-0167). NTIS, PC A02/MF A01.

Pub. in SPIE, Vol. 687, 90-103(1986).

The design of a multi-mode instrument known as the Auroral Ionospheric Remote Sensor, AIRS, is described. The goal of the AIRS instrument is to produce data on the global imaging of the auroral display in both dark and sunlit hemispheres with the remote sensing of ionospheric airglows to deduce ionospheric parameters such as electron-density profiles and atmospheric background emissions. The AIRS will fly on a the POLAR BEAR spacecraft in a near-polar circular orbit at an altitude of 1000 km with a scheduled launch in the fall of 1986. The AIRS instrument is designed as a multi-mode system with four (4) channels of data to yield simultaneous operation in the vacuum ultraviolet (VUV), near ultraviolet (UV), and visible spectral bands. Two of the data channels are designed to operate in the VUV with 30A windows having a 240A separation. These two channels utilize an Ebert-Fastile spectrometer which can provide total coverage for each of these channels from 1150A to 1800A. The other two channels utilize a filter selector system to provide preselected, 10A bandwidth spectral channels at 3371A, 3914A, and 6300A, and a 200A wide channel centered at 2250A. These spectral bands are paired to provide simultaneous pair coverage of 2250A and 3371A and simultaneous pair coverage of 3914A and 6300A. All four channels view the auroral scene of the north polar cap via appropriate optics and scan mirror system. In effect, a line-scan image of the auroral scene is produced via the scan mirror operating in the orbit cross plane with the longitudinal direction provided by the forward motion of the spacecraft.

46398 **(AD-A—181362/5/XAB) Ionospheric convection associated with discrete levels of particle precipitation.** Foster, J.C.; Holt, J.M.; Musgrove, R.G.; Evans, D.S. (Haystack Observatory, Westford, MA (USA)). Jul 1986. 6p. NTIS, PC A02/MF A01.

Pub. in Geophysical Research Letters, Vol. 13, No. 7, 656-659(Jul 1986); Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

A precipitation index is described which quantifies the intensity and spatial extent of high-latitude particle precipitation based on observations made along individual satellite passes. By sorting plasma-convection data according to this index, average patterns of the ionospheric convection electric field were derived from a data set consisting of five years' observations by the Millstone Hill radar. Reference to the instantaneous precipitation index, and the average patterns keyed to it, provides a means of characterizing the global precipitation and convection patterns throughout an event.

46399 **(AD-A—181456/5/XAB) Analytic and observational approaches to spacecraft auroral charging. Technical report.** Barker, T.G. (S-Cubed, San Diego, CA (USA)). Nov 1986. 47p. (SSS-R—87-8377). NTIS, PC A03/MF A01.

The objective of this report is to present a set of computational tools that can be used to process large quantities of observations of auroral electron and ion fluxes to yield estimates of the likelihood of spacecraft charging. The tools and procedures would be tested on the DMSP observations of environments and spacecraft charging, and then be used to predict the levels of charging for the shuttle in polar orbits. The first approach, the subject of Section II, is to fit the observed spectra to analytic functions which can then be manipulated to find the charging potential. The analytic functions proposed by Fontheim, et al., (1985), to represent electron flux spectra, are parameterized by a set of observable physical parameters. The second approach, described in Section III, is to numerically integrate the observations directly. The second approach is more appropriate for large numbers of spectra, while the first provides physical parameters which give insight to the nature of the precipitating electron environment. The appendix of this report is a user's manual for the computer programs that perform these tasks.

46400 **(AD-A—181459/9/XAB) Atmospheric structure variations: modeling of atmospheric structure, 70 - 130 km. Final report, 1 January 1984-31 December 1986.** Groves, G.V. (University Coll., London (UK). Dept. of Physics and Astronomy). 27 Apr 1987. 82p. NTIS, PC A05/MF A01.

Theory and numerical analysis of data were applied to a number of leading problems of atmospheric structure in the upper mesosphere/lower thermosphere during the three years of this project. Three investigations occupied the first 18 months and concerned: (1) diurnal and semidiurnal tidal dissipation of momentum and energy in the upper atmosphere, (2) modeling of O distribution from 85 km to the turbopause, and (3) an empirical model for solar cycle changes in mesospheric structure. During the second part of the project, attention was concentrated on: (4) atmospheric modeling of the intermediate region (70-130km) between given models for the lower (up to 70 km) region and the upper (above 130 km) region. A preliminary report of this work, to the extent that it might meet the needs of a new COSPAR reference atmosphere, was presented at the 1986 COSPAR meeting and a detailed report of the theory and analyses was subsequently completed.

46401 **(AD-A—181730/3/XAB) Remote sensing of ionosphere by using ultraviolet and visible emissions.** Meng, C.I.; Huffman, R.E.; Skrivanek, R.A.; Strickland, D.J.; Daniell, R.E. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 12p. (AFGL-TR—87-0166). NTIS, PC A02/MF A01.

Pub. in SPIE Ultraviolet Technology, Vol. 687, 62-72(1986).

The ability to remotely sense ionospheric conditions for improved operation of communications and radar systems has been a long term goal of some DOD programs. This capability now appears to be possible through improvements in computer models of the ionosphere and in UV remote-sensing methods. The approach is to use passive ultraviolet optical measurements and in-situ ion-density measurements as inputs to a comprehensive ionospheric model, which will calculate the electron-density measurements as inputs to a comprehensive ionospheric model which will calculate the electron-density profile. A novel feature of this approach is the use of naturally occurring airglow and auroral ultraviolet radiation. This method can be used for the mid-latitude day ionosphere (90 to 800 km) and the night auroral E layer. Eventually, extensions of the technique will cover the night mid-latitude as well. The remote-sensing measurement can also be used to locate regions of ionospheric irregularity, and hence probable phase scintillation, in both equatorial and polar-cap regions and to locate the real-time position of the auroral-oval particle precipitation.

46402 (PB—87-196622/XAB) Travelling ionospheric disturbances and their effects on radio propagation. Lambert, S. (National Inst. for Telecommunications Research, Johannesburg (South Africa)). 1982. 26p. (TEL—187). NTIS, PC PC E05/MF E05.

North American Continent sales only.

The report has shown that it is possible ... model the signatures of TIDs (Traveling Ionospheric Disturbances) on vertical ionograms semiquantitatively. Many, although not all, of the properties of TIDS can be deduced from vertical ionograms from a single station. Qualitative predictions about the behavior of oblique ray paths during the course of a TID and, in particular-the variation of the angles of arrival, were made.

46403 (UCID—21145) Production of NO by galactic cosmic rays and lightning. Grant, K.E.; Wuebbles, D.J. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014613.

As part of the ongoing development of the LLNL 2-D Stratospheric Transport-Kinetics Model, values for NO production rates due to galactic cosmic rays (GCRs) and lightning have been calculated. With the combined NO production rates from GCRs and lightning included in the LLNL 2-D model, we compared our predicted NO/sub y/ mixing ratios with those from LIMS (Limb Infrared Monitor of the Stratosphere) data and other models. Although our predicted NO/sub y/ mixing ratios are lower than the LIMS data at 16 mb and 30 mb, our values at these pressures are generally higher and in better agreement with LIMS than are the corresponding mixing ratios from other models. Further research is needed on the sensitivity of these results to changes in model transport processes. 12 refs., 1 fig., 5 tabs.

46404 Direct production of ion conics by plasma double layers. Borovsky, J.E.; Joyce, G. pp 317-322 of Ion acceleration in the magnetosphere and ionosphere; Proceedings of the Chapman Conference on Ion Acceleration in the Magnetosphere, Wellesley College, MA, June 3-7, 1985. Chang, T. Washington, DC; American Geophysical Union (1986). (CONF-8506196—).

From Chapman conference on ion acceleration in the magnetosphere and ionosphere; Wellesley, MA, USA (3 Jun 1985).

In this report, the electrostatic potential structures associated with multiple auroral arcs are briefly considered. The structure of these magnetized double layers are examined and the production of high-altitude, high-energy, gyrophase-bunched ion conics by ion acceleration upward through such magnetized double layers is discussed, as is the driving of electrostatic ion-cyclotron waves by these conics. The production of low-energy heavy-ion conics at low altitudes by moving arc structures is also briefly examined, as is the upward acceleration of ionospheric ions by very narrow ionospheric sheaths is discussed. Finally, the implication for future spacecraft measurements are discussed. 20 references.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 45181, 45716, 45997, 46003, 46005, 46122, 46563, 46723, 46740, 46826, 46867, 46868, 46889, 46906

46405 (AD-A—181359/1/XAB) Emission characteristics of the ZrO/W thermal-field electron source. Tuggle, D.W.; Swanson, L.W. (Oregon Graduate Center, Beaverton (USA)). Feb 1985. 5p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology B, Vol. 3, No. 1, 220-223(Jan-Feb 1985).

The zirconium oxide/tungsten thermal field emitter (TFE) has proven to be a useful high-brightness electron source for a variety of microprobe applications. Desirable source characteristics are: 1 to 2 mA/sr angular intensity, 1 to 1.5% noise level between 1 Hz and 25 kHz. This study examines the effect of the faceted shape of the ZrO/W TFE on the angular distribution of the emission and virtual source size. In particular, the SCWIM computer program is employed to compare the emission characteristics of faceted and spherical shaped emitters. The computer-derived results agree qualitatively with experimental angular emission distributions measured for various emitter radii. It is shown that the high angular intensity obtained from the ZrO/W TFE is due in part to a large angular demagnification caused by the faceted-emitter region. Nevertheless, a comparison of the virtual source size of the facted and the spherical shapes shows only a small-source image increase due to faceting. The minimum values of virtual source size at an angular intensity of 1 mA/sr for the spherical and faceted emitters are 8 and 12 nm, respectively.

46406 (AD-A—181521/6/XAB) Theoretical studies of dissociative recombination. Guberman, S.L. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (USA)). 1986. 20p. NTIS, PC A02/MF A01.

Pub. in Thermophysical Aspects of Re-Entry Flows, Vol. 103, 225-242(1986).

The calculation of dissociative recombination rates and cross sections over a wide temperature range by theoretical quantum-chemical techniques is described. Model calculations on electron capture by diatomic ions are reported that illustrate the dependence of the rates and cross sections on electron energy, electron temperature, and vibrational temperature for three model crossings of neutral and ionic potential curves. Using harmonic-oscillator vibrational wave functions, it is shown that cross sections for recombination to the lowest vibrational level of the ion can vary by several orders of magnitude, depending upon the position of the neutral and ionic potential curve crossing within the turning points of the V=1 vibrational level. A new approach for calculating electron-capture widths is reported. Ab initio calculations are described for recombination of $0^+ 211$ leading to excited O atoms.

46407 (CONF-870715—4) Correlation effects on double electron capture in highly-charged, low-energy ion-atom collisions. Meyer, F.W.; Griffin, D.C.; Havener, C.C.; Huq, M.S.; Phaneuf, R.A.; Swenson, J.K.; Stolterfoht, N. (Oak Ridge National Lab., TN (USA); Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013179.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

The method of zero-degree Auger electron spectroscopy has been used to study two-electron excited states populated in slow double capture collisions of highly charged ions with He and H_2. The focus of this study is on production of autoionization electrons originating from the non-equivalent $1s^22pnl$ electron configurations in comparison with electron production resulting from the Auger decay of (near) equivalent $1s^2nln'l'$ (with $n \sim n'$) configurations. It is shown that production of non-equivalent electron configurations is significant and involves electron-electron correlation effects whose analysis leads beyond the independent-particle model. Recent results that include a measurement at non-zero angles are presented to illustrate the angular dependence of electron emission from non-equivalent electron configurations, as well as the dependence on projectile charge state and target species. Comparison of high resolution scans over two lines of the $1s^22pnl$ sequence for the O^{6+} + He system with accurate transition energy calculations shows preferential population of high angular momentum substation.

46408 (CONF-870759—2) Low energy electron drift and scattering in krypton and xenon. Hunter, S.R.; Carter, J.G.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. File Number DE87010395.

From 5. international swarm seminar; Birmingham, UK (29 Jul 1987).

In the present study, the measurement of electron drift velocities in Kr and Xe which has enabled the calculation of the σ/sub m/(ϵ) cross sections for these two molecules over the electron energy range $0.01 \leqq \epsilon \leqq 5$ eV. The pulsed Townsend (PT) technique was used to obtain these measurements. Particular attention has been paid to gas purity in the present study, realizing that parts per million or less of a molecular impurity in these gases can have a profound influence on the experimental measurements. Electron drift velocity measurements are also compared with results from previous experiments.

46409 **(CONF-870789—2) Influence of internally generated fields on odd-photon pumping of dipole-allowed transitions in atomic gases.** Garrett, W.R. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012530.

From International conference on multiphoton processes; Boulder, CO, USA (13 Jul 1987).

The dramatic influence of multiwave mixing processes on resonant multiphoton excitation of dipole-allowed quantum transitions are discussed. Brief comparisons are made between different theoretical approaches used in treating the same underlying physics, and between the predictions and available experimental manifestations of the phenomenon for three-photon and five-photon induced processes.

46410 **(DOE/ER/13630—1) Many-body processes in atomic and molecular physics: Technical progress report, September 1, 1986 through August 31, 1987.** Chu, Shih-I. (Kansas Univ., Lawrence (USA)). Apr 1987. Contract FG02-86ER13630. 2p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013459.

This program is directed towards the development of new theoretical formalisms and practical computational methods for ab initio investigation of the structure and quantum dynamics of atoms and molecules in intense laser fields. This report contains some of the major accomplishments over the past year like the investigation of collisional processes in the presence of laser fields and an approach to intense field multiphoton nonlinear optical processes. (LSP)

46411 **(DOE/ER/60503—295) A physico-chemical study of some areas of fundamental significance to biophysics: Annual report, 1986-1987.** McGlynn, S.P. (Louisiana State Univ., Baton Rouge (USA)). 1 Jul 1987. Contract FG05-87ER60503. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013457.

The thirteen (13) titles (Nos. 283 to 295) of the Bibliography for the 1986 to 1987 Annual Report constitute the gist of this document. These titles represent work completed and published (or in process of publication). The scientific report which follows is intended to provide a brief summary of the ongoing research efforts of the Molecular Spectroscopy Group. The titles covered are as follows: Rare Gas Density Effects on High-M Rydberg States, Electric Field Dependence of the Total Excimer Luminescence of Xenon Excited Below the Atomic Ionization Limit, Term Value/Band-Gap Energy Correlations for Solid Rare Gas Excitons, Laser Optogalvanic Spectroscopy of Iodine and Cesium, Photoionization spectroscopy of Highly Polar Aromatics, Photochemistry of Polyatomic Molecules. There are six individual papers listed separately in this report. (LSP)

46412 (DOE/ER/60503—295, pp 14-24) **Rare gas density effects on high-n Rydberg states.** 1 Jul 1987. NTIS, PC A04/MF A01. File Number DE87013457.

In A physico-chemical study of some areas of fundamental significance to biophysics: Annual report, 1986-1987.

This report provides experimental results on the effect of increasing rare gas number density on the energy postions of high-n Rydberg states of CH_3I, as measured by absorption spectroscopy. In addition, an analysis is provided of these data within the context of the Fermi model, and a recent extension of this model which incorporates a linear dependence of the polarization energy on the perturber number density. It is important to note that the rare gas number densities considered here are more than one order of magnitude larger than those previously employed in atomic studies.

46413 (DOE/ER/60503—295, pp 25-33) **Electric field dependence of the total excimer luminescence of xenon excited below the atomic ionization limit.** 1 Jul 1987. NTIS, PC A04/MF A01. File Number DE87013457.

In A physico-chemical study of some areas of fundamental significance to biophysics: Annual report, 1986-1987.

In the spectral region of interest (i.e., 11.1 eV $\leqq$ h nu $\leqq$ 11.9 eV), the photoionization yield of electrons from excited-state dimers of xenon, increases monotonically to relatively high values (e.g., Y(11.7 eV) = 0.43 electrons/absorbed photon). It is also known however, that the luminescence intensity excited by photons in this region is quite high, even at low pressures. These two observations can be reconciled only by assuming that one of the processes leading to excimer luminescence involves dimer-ion + electron recombination. If this assumption is correct, application of an electric field, with concomitant collection of the free charges generated by the incident photons, should lead to a decrease in luminescence intensity; moreover, this decrease should follow the energy dependence of the photoionization yield function. The present report demonstrates experimentally that this is indeed the case. Such experiments combining luminescence and electric fields were made, until now, only by high-energy excitation. In this case the deconvolution of the various decay channels is hardly possible.

46414 (DOE/ER/60503—295, pp 34-43) **Term value/band-gap energy correlations for solid rare gas excitons.** 1 Jul 1987. NTIS, PC A04/MF A01. File Number DE87013457.

In A physico-chemical study of some areas of fundamental significance to biophysics: Annual report, 1986-1987.

Term value/ionization energy correlation algorithms have proven to be of considerable utility in the assignment of atomic and molecular Rydberg states. Many examples of empirical term value/ionization energy correlations are known for diverse classes of atoms and molecules. The purpose of this paper is to demonstrate that similar correlations are also obtained for excitons in rare gas solids. (LSP)

46415 (DOE/ER/60503—295, pp 44-47) **Laser optogalvanic spectroscopy of iodine and cesium.** 1 Jul 1987. NTIS, PC A04/MF A01. File Number DE87013457.

In A physico-chemical study of some areas of fundamental significance to biophysics: Annual report, 1986-1987.

Laser optogalvanic (LOG) spectroscopy, using visible/near-visible lasers, is a powerful tool for probing the high-energy (i.e., Rydberg) states of atoms and small molecules. This technique can also be used to study the ions and radicals produced in a plasma discharge. In particular this paper looks at iodine and cesium using this technique.

46416 (DOE/ER/60503—295, pp 48-53) **Photoionization spectroscopy of highly polar aromatics.** 1 Jul 1987. NTIS, PC A04/MF A01. File Number DE87013457.

In A physico-chemical study of some areas of fundamental significance to biophysics: Annual report, 1986-1987.

Highly polar aromatics constitute a broad class of organic molecules possessing both technological and biological importance. Unfortunately, the inherent complexity of such molecules often precludes any detailed photophysical investigation. It is useful, therefore, to examine the electronic structure of simple, prototypical aromatic systems in an attempt to gain the insight necessary for understanding the more complicated highly polar molecules. To this end, reported is the gas phase photoionization spectra for benzene and a series of o,m,p-substituted D-benzene-A molecules, where D is an electron donor (e.g., F) and A is an electron acceptor (e.g., CN) substituent.

46417 (DOE/ER/60503—295, pp 54-55) **Photochemistry of polyatomic molecules.** 1 Jul 1987. NTIS, PC A04/MF A01. File Number DE87013457.

In A physico-chemical study of some areas of fundamental significance, to biophysics: Annual report, 1986-1987.

The paper lists some of the problems associated with determining the detailed photochemical behavior of polyatomic molecules. (LSP)

46418 **(DOE/ER/60503—T1) Laser optogalvanic and photoacoustic studies of some atoms and small molecules.** Clancy, P.L. (Louisiana State Univ., Baton Rouge (USA). Dept. of Chemistry). Dec 1986. Contract FG05-87ER60503. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87013458.

A device designed to perform laser optogalvanic (LOG) measurements on low pressure gases in an electrical discharge has been constructed. The device employs the unique combination of

pulsed laser radiation in the visible range, and transverse excitation of a radiofrequency (rf) discharge to obtain high quality spectroscopic data on highly excited atomic and molecular species existing in an electrical discharge. The results of LOG studies on xenon, cesium, and nitrogen are reported. In addition to functioning as a sensitive LOG detector, it has been discovered that the RFLOG device serves admirably as a contactless transducer of the photoacoustic signal. When the laser beam is focused into a region of the discharge cell some distance below the area of the discharge, excitation of ground state species gives rise to an acoustic wave through the photoacoustic effect. The acoustic wave causes a perturbation of the rf discharge which is detected by the RFLOG device. Results of a study on magnetic field induced level crossings in molecular iodine using photoacoustic detection with the RFLOG device are presented. Finally, pulsed excitation has made possible time resolved studies of the response of the rf discharge to laser excitation. In studies on molecular iodine, it has been observed that subsequent to each laser pulse, two distinct signals are obtained. A fast signal, corresponding to absorption by iodine atoms occurs immediately upon pulsed excitation. A slower signal corresponding to absorption by molecular iodine follows some 200μs later. The results are presented, and discussed in terms of the mechanism of the optogalvanic effect in atomic and molecular systems.

46419 (DOE/ET/53088—288) Superdense muonic matter. Tajima, T. (Texas Univ., Austin (USA)). Jul 1987. Contract FG05-80ET53088. 18p. (IFSR—288). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014421.

A possible method of creation of superdense matter with approximate atomic density $4 \times 10^{29} cm^{-3}$ is suggested. A pulsed beam of 10^8 muons, with duration 3×10^{-6}sec is shone on liquid hydrogen of volume $\sim(300A)^3$. A muon charge-exchanges with an electron in a hydrogen atom: with enough muonic hydrogen atoms, the compressibility tends to diverge and condensation into a much higher density state begins. The muon beam should be cooled by the ionization process and channeled through crystal axes before irradiation on the hydrogen specimen. When magnetic fields are present upon irradiation, the fields may be enhanced up to 10^9 Gauss. A possible state of this matter is speculated.

46420 (GSI—87-26-Prepr.) Electron-positron pair creation in heavy ion collisions and Bhabha scattering in the MeV range. Kienle, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1987. 6p. (CONF-870413—8-Prepr.). NTIS, PC E07; Available from NTIS as TIB/B87-10822.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

We report first results of high resolution e/sup +/-spectra from lower Z/sub u/ systems (164 $\leqq$ Z/sub u/ $\leqq$ 171) and (e/sup +/-e/sup -/) coincidence spectra from U-Th collisions.

46421 (IC—86/356) Spin flip inelastic scattering in electron energy loss spectroscopy of a ferromagnetic metal. Bocchetta, C.J.; Tosatti, E.; Yin, S. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87703080.

A model ferromagnetic metal is used to calculate the spin-polarization which occurs during inelastic electron-metal scattering with the production of an electron-hole pair. The polarization is found to have contributions from unequal spin-flip as well as non-flip energy loss rates. Our results indicate an asymmetry of the order of a few percent with parameters roughly modelling iron. 17 refs, 25 figs, 1 tab.

46422 (INIS-SU—404) Study on the xenon radiation ultrasoft X-ray spectra in the 52-94 eV photon energy range. Verkhovtseva, Eh.T.; Gnatchenko, E.V.; Pogrebnyak, P.S.; Tkachenko, A.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1985. 37p. (In Russian). (Preprint-no—12-85). NTIS (US Sales Only), PC A03/MF A01. File Number DE87703107.

An ultrasoft X-ray emission spectrum of Xe in the photon energy range 52-94 eV is studied at various energies of bombardment electrons from 0.14 to 2 keV. Spectrum radiators, processes of their formation and electronic transitions at which ultrasoft X-ray radiation appears are found. The spectrum peculiarities are detected which are caused by correlation effects, in a number of cases the nature of correlations is determined. 37 refs.; 6 figs.; 4 tabs.

46423 (IS-T—1310) Direct detection of optical radiation through a sampling orifice for inductively coupled plasma atomic emission spectroscopy. LaFreniere, B.R. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 212p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87013609.

The direct optical viewing of an argon inductively coupled plasma (ICP) through a sampling orifice inserted directly into the plasma has been accomplished. A copper cone with a sampling orifice is attached to the entrance slit chamber of a monochromator and inserted directly into an ICP to obtain optical spectra in the vacuum ultraviolet (VUV). With solar-blind photomultiplier tube (PMT) detection, detection limits are 50 ng mL^{-1} for the resonance lines of Br and Cl during injection into the plasma of aerosols of aqueous solutions generated by pneumatic nebulization. With ultrasonic nebulization, the detection limits improve to 8 ng mL^{-1} for Br and 15 ng mL^{-1} for Cl. Detection limits for Br and Cl in the form of an aqueous sample were superior to the best reported values in the Ar and He ICP, and in the microwave-induced plasma atomic emission spectroscopy (MIP-AES) literature. Another significant breakthrough in the present work includes the determination of nonmetals in gases by their direct injection into the ICP by a device called a direct injection probe (DIP). This low dead volume interface (<40 μL) is used for the introduction of gaseous samples directly into the axial channel of the ICP. Injection of a gaseous mixture of compounds containing the elements Br, Cl, S, and C results in detection limits of 0.1, 0.3, 0.05, and 1 ng, respectively. These detection limits are by far the best obtained for these elements in a gaseous form by ICP-AES. The extension of ICP-AES analysis to the determination of nonmetals, metalloids, and/or selected metals in aqueous and gaseous samples illustrates the value of this optical sampling approach in the VUV. 174 refs., 50 figs.

46424 (LA-UR—87-2311) IR laser excitation in molecules: Chaos and diffusive energy growth. Ackerhalt, J.R.; Milonni, P.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-870784—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013147.

From NATO workshop on atomic and molecular processes with short intense laser pulse; Sherbrooke, Canada (19 Jul 1987).

After a short review of a generic vibrational model of ir multiple-photon excitation, the model is generalized to include rotations. It is shown that the combination of chaotic dynamics and rotational averaging leads to fluence-dependent absorption which removes the sensitivity of the results to model-dependent parameters. The classical rotation-vibration dynamics observed in this model correlate very well with quantum intuition based on a molecule's P, Q, and R-branch structure and on the red-shift of the vibrational absorption with excitation. The implication of these results for MPE experiments is discussed.

46425 (LA-UR—87-2322) Quantum-mechanical aspects of classically chaotic driven systems. Milonni, P.W.; Ackerhalt, J.R.; Goggin, M.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-870789—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013152.

From International conference on multiphoton processes; Boulder, CO, USA (13 Jul 1987).

This paper treats atoms and molecules in laser fields as periodically driven quantum systems. The paper concludes by determining that stochastic excitation is possible in quantum systems with quasiperiodic driving. 17 refs. (JDH)

46426 **(LBL—23426) Performance comparisons of low emittance lattices.** Delahaye, J.P.; Zisman, M.S. (Lawrence Berkeley Lab., CA (USA); European Organization for Nuclear Research, Geneva (Switzerland)). May 1987. Contract AC03-76SF00098. 14p. (CONF-8703149—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014127.

From Workshop on low emittance beams; Upton, NY, USA (1 Mar 1987).

In this paper, the results of a performance analysis of several low emittance electron storage ring lattices provided by various members of the Lattice Working Group are presented. Altogether, four lattices were investigated. There are two different functions being considered for the low beam emittance rings discussed here. The first is to serve as a Damping Ring (DR), i.e., to provide the emittance damping required for a high energy linear collider. The second is to provide beams for a short wavelength Free Electron Laser (FEL), which is envisioned to operate in the wavelength region near 40 A.

46427 **(LBL—23588) Reactive scattering of electronically excited alkali atoms with molecules.** Mestdagh, J.M.; Balko, B.A.; Covinsky, M.H.; Weiss, P.S.; Vernon, M.F.; Schmidt, H.; Lee, Y.T. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 39p. (CONF-8709113—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE87012878.

From Faraday discussion on dynamics of elementary gas phase reactions; Birmingham, UK (14 Sep 1987).

Representative families of excited alkali atom reactions have been studied using a crossed beam apparatus. For those alkali-molecule systems in which reactions are also known for ground state alkali and involve an early electron transfer step, no large differences are observed in the reactivity as Na is excited. More interesting are the reactions with hydrogen halides (HCl): it was found that adding electronic energy into Na changes the reaction mechanism. Early electron transfer is responsible of Na(5S, 4D) reactions, but not of Na(3P) reactions. Moreover, the NaCl product scattering is dominated by the HCl^- repulsion in Na(5S, 4D) reactions, and by the NaCl-H repulsion in the case of Na(3P). The reaction of Na with O_2 is of particular interest since it was found to be state specific. Only Na(4D) reacts, and the reaction requires restrictive constraints on the impact parameter and the reactants' relative orientation. The reaction with NO_2 is even more complex since Na(4D) leads to the formation of NaO by two different pathways. It must be mentioned however, that the identification of NaO as product in these reactions has yet to be confirmed.

46428 **(NBSIR—87-3597) XCOM: Photon cross sections on a personal computer.** Berger, M.J.; Hubbell, J.H. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Jul 1987. Contract AI05-86ER60390. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013948.

A computer program and data base are presented which can be used to calculate, with a personal computer, photon cross sections for scattering, photoelectric absorption and pair production, as well as total attenuation coefficients, in any element, compound or mixture, at energies from 1 keV to 100 GeV.

46429 **(PNL-SA—13662) Development of beta calibration sources at the Pacific Northwest Laboratory.** Roberson, P.L.; Jones, K.L.; Braby, L.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 10p. (CONF-860149—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012170.

From DOE beta measurement workshop; Albuquerque, NM, USA (23 Jan 1986).

The Pacific Northwest Laboratory is developing and improving beta and monoenergetic electron sources. This paper describes progress on (1) modifications to allow the use of larger area sources in the Buchler irradiator jig; (2) development of a monoenergetic electron beam capability; and (3) the use of measurement criteria for the standardization of beta sources.

46430 **(SAND—87-0065) LID: Computer code for identifying atomic and ionic lines below 3500 Angstroms.** Peek, J.M.; Dukart, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014014.

An interactive computer code has been written to search a data base containing information useful for identifying lines in experimentally-observed spectra or for designing experiments. The data base was the basis for the Kelly and Palumbo critical review of well-resolved lines below 2000 Angstroms, includes lines below 3500 Angstroms for atoms and ions of hydrogen through krypton, and was obtained from R.L. Kelly. This code allows the user to search the data base for a user-specified wavelength region, with this search either limited to atoms or ions of the user's choice for all atoms and ions contained in the data base. The line information found in the search is stored in a local file for later reference. A plotting capability is provided to graphically display the lines resulting from the search. Several options are available to control the nature of these graphs. It is also possible to bring in data from another source, such as an experimental spectra, for display along with the lines from the data-base search. Options for manipulating the experimental spectra's background intensity and wavelength scale are also available to the user. The intensities for the lines from each ion found in the data-base search can be scaled by a multiplicative constant to better simulate the observed spectrum.

46431 **(SAND—87-2016C) Effect of collisional broadening on the polarizability of a two-dimensional electron gas.** Lyo, S.K. (Sandia National Labs., Albuquerque, NM (USA)). 17 Aug 1987. Contract AC04-76DP00789. 7p. (CONF-8708112—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87013928.

From 3. international conference on superlattices, microstructures and microdevices; Chicago, IL, USA (17 Aug 1987).

The effect of collisional damping (Γ) of electronic levels on the Lindhard polarizability is studied for a degenerate two-dimensional electron gas interacting with ionized impurities using an effective mass approximation. A specific wave-vector dependence as well as the Γ-dependence of the correction to the polarizability is obtained. The consequence of this result on the low-temperature mobility is discussed.

46432 **(UCRL—15932) Theoretical atomic and molecular photophysics.** Eberly, J.H. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy; Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014249.

We report the results of a theoretical study of long-path stimulated Raman scattering and amplified spontaneous emission in an idealized atomic absorber, under coherent transient conditions and allowing for collisional and Doppler broadening effects.

46433 **(UCRL—96217) Measurements of electron excitation and recombination for Ne-like Ba^{46+}.** Marrs, R.E.; Levine, M.A.; Knapp, D.A.; Henderson, J.R. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 7p. (CONF-870715—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013229.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

A new facility at Lawrence Livermore National Laboratory has been used to obtain measurements for electron-impact excitation, dielectronic recombination and radiative recombination for the neon-like Ba^{46+} ion. The experimental technique consists of trapping highly charged ions inside the space charge of an electron beam and measuring their x-ray emission spectra.

46434 **(UCRL—96870) Streamlined Darwin methods for particle beam injectors.** Boyd, J.K. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 6p. (CONF-870947—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013228.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

Physics issues that involve inductive effects, such as beam fluctuations, electromagnetic (EM) instability, or interactions with a cavity require a time-dependent simulation. The most elaborate time-dependent codes self-consistently solve Maxwell's equations and the force equation for a large number of macroparticles. Although these full EM particle-in-cell (PIC) codes have been used to study a broad range of phenomena, including beam injectors, they have several drawbacks. In an explicit solution of Maxwell's equations, the time step is restricted by a Courant condition. A second disadvantage is the production of anomalously large numerical fluctuations, caused by representing many real particles by a single computational macroparticle. Last, approximate models of internal boundaries can create nonphysical radiation in a full EM simulation. In this work, many of the problems of a fully electromagnetic simulation are avoided by using the Darwin field model. The Darwin field model is the magnetoinductive limit of Maxwell's equations, and it retains the first-order relativistic correction to the particle Lagrangian. It includes the part of the displacement current necessary to satisfy the charge-continuity equation. This feature is important for simulation of nonneutral beams. Because the Darwin model does not include the solenoidal vector component of the displacement current, it cannot be used to study high-frequency phenomena or effects caused by rapid current changes. However, because wave motion is not followed, the Courant condition of a fully electromagnetic code can be exceeded. In addition, inductive effects are modeled without creating nonphysical radiation.

46435 **(UCRL—96942) Theory of multiphoton ionization.** Szoeke, A. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 24p. (CONF-870784—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013792.

From NATO workshop on atomic and molecular processes with short intense laser pulse; Sherbrooke, Canada (19 Jul 1987).

A consistent, quantum-mechanical, many-body theory of multiphoton excitation and ionization is reviewed. The laser pulse is considered to be a classical field consisting of many optical cycles of a single, slowly varying frequency. The results are useful both for numerical calculations and for qualitative interpretation of experiments.

46436 **Quantum reactive scattering in three dimensions using hyperspherical (APH) coordinates. Theory.** Pack, R.T.; Parker, G.A. (Theoretical Division (T-12, MS J569), Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **87**: No. 7, 3888-3921(1 Oct 1987).

The theory of reactive (rearrangement) scattering for three atoms in three physical dimensions using adiabatically adjusting, principal axes hyperspherical (APH) coordinates is given. The relationships of the APH coordinates to Delves and Jacobi coordinates are given, and the kinetic energy operator is shown to be relatively simple. Procedures for solving the equations via either an exact coupled channel (CC) method or an optimum centrifugal sudden (CS/sub APH/) approximation are given as well as procedures for applying scattering boundary conditions. Surface functions of two angles are obtained using a finite element method with an optimized, nonuniform mesh, and the CC equations are solved using the efficient VIVAS method. Sample CC results are given for the H_3 system. The present approach has the advantages that all arrangements are treated fully equivalently; it is a principal axis system, so that both axes and internal coordinates swing smoothly with the reactions; it is directly applicable to both symmetric and unsymmetric systems and mass combinations and all total angular momenta; it gives convenient mappings for visualization of potential energy surfaces and wave functions; only regular radial solutions are required; all coordinate matching is by simple projection; and the expensive parts of the calculation are energy independent, so that, once they are done, the scattering matrices can be rapidly generated at the large numbers of energies needed to map out reactive thresholds and resonances. Accurate reactive scattering calculations are now possible for many chemically interesting reactions that were previously intractable.

46437 **Electron degradation and yields of initial products. I. Excited species generated by electrons in binary mixtures.** Kimura, M.; Inokuti, M. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **87**: No. 7, 3875-3879(1 Oct 1987). Contract W-31-109-ENG-38.

Initial yields of excited species resulting from electron degradation in $Ar+H_2$ mixtures have been calculated using the Fowler equation. Following up the previous study of yields of ions by Eggarter [J. Chem. Physl 84, 6123 (1986)] and by Inokuti and Eggarter [J. Chem. Phys. 86, 3870 (1987)], the present work treats initial yields of excited species over the entire range of the composition of $Ar+H_2$ mixtures. The variation of the yield with the composition depends on the kind of excited species. The most noteworthy of the results obtained concerns the Ar metastable-state yield, which shows peculiar behavior when a small amount of H_2 is introduced in the media.

46438 **Relativistic calculations of electronic states of PdH.** Balasubramanian, K.; Feng, P.Y.; Liao, M.Z. (Department of Chemistry, Arizona State University, Tempe, Arizona 85287). *Journal of Chemical Physics;* **87**: No. 7, 3981-3985(1 Oct 1987).

Complete active space MCSCF(CASSCF)/first-order configuration interaction (FOCI) calculations followed by relativistic configuration interaction (RCI) calculations are carried out on $^2\Sigma^+$, ^2Pi, $^2\Delta$, and $^2\Sigma^+$(II) λ—s states and 1/2, 3/2, 1/2(II), 3/2(II), and 5/2 ω—ω states of PdH. Our calculations predict that the ground state is $^2\Sigma^+$/sub 1/2/. The spin—orbit splitting and contamination of the excited states (^{2}Pi and $^2\Delta$) are quite large. The two 3/2 states are quite mixed [3/2(I): 66% $^2\Delta_3$/sub //$_2$, 29% $^2Pi_3$/sub //$_2$] in character. The spectroscopic properties (R/sub e/, T/sub e/, D/sub e/, and ω/sub e/) of all the above states are calculated and compared with available experimental results on the ground state of PdD. The Mulliken population analysis of the low-lying states of PdH shows that the $^2\Sigma^+$ state is ionic (Pd^+H^-) but the excited ^{2}Pi and $^2\Delta$ states are a bit more ionic with the same polarity as the ground state. The 3/2 state exhibits an interesting avoided crossing.

46439 **Nuclear quadrupole moment of ^{14}N. A theoretical prediction from full valence shell and full configuration interaction atomic wave functions.** Scuseria, G.E.; Schaefer H.F. III. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 7, 4020-4024(1 Oct 1987). Contract AC03-76SF00098.

Full configuration interaction ab initio studies of the 2p 3p $^1P_1$ state of N^+ are carried out in order to obtain the molecular electric field gradient at the nitrogen nucleus. A careful calibration of the basis set leads to a q value (-0.94 a.u.) obtained using a <13s9p5d2f/10s7p5d2f> basis set with an estimated accuracy of +- 0.01 a.u. Combined with the experimental nuclear quadrupole coupling constant for this system, we predict the nuclear quadrupole moment of ^{14}N to be Q(^{14}N) = (20.7 +- 0.4) mb.

46440 **Electron-impact spectroscopy of acetaldehyde.** Walzl, K.N.; Koerting, C.F.; Kuppermann, A. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **87**: No. 7, 3796-3803(1 Oct 1987).

Acetaldehyde has been studied by the technique of low-energy variable-angle electron energy-loss spectroscopy. With this method the low-lying spin-forbidden transitions have been located via the behavior of the relative differential cross sections, providing the first identification by this technique of such states in acetaldehyde. High-lying states were also investigated and some assignments of dipole symmetry-forbidden/quadrupole symmetry-allowed excitations were made on the basis of characteristic angular behavior, evident for the asymmetric molecule acetaldehyde just as for the symmetric molecules formaldehyde and acetone. Through a comparison of the acetaldehyde results with those for formaldehyde and acetone the trends in the allowed and forbidden transition energies were examined as a function of methyl substitution and found to be relatively linear.

46441 **Monte Carlo algorithm for calculating moments of atomic transition arrays.** Bloom, S.D.; Goldberg, A. (Lawrence Livermore National Laboratory and the Department of Applied Science, University of California, Davis, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 7, 3152-3154(1 Oct 1987).

A new method for calculating moments of atomic transition arrays is described. It is based on the collective vector method described in earlier publications. In this new approach a single collective state vector is generated from a single parent state vector encompassing the entire parent basis. The amplitudes of the basis vectors comprising the parent state vector are randomized. Thus it is representative of the entire parent manifold. We show that a statistical estimate of the transition moments of the array is given by a suitable combination of moments of the matrix element of the E1 (electric dipole) operator between the representative parent state vector and the collective state vector derived from it. Although the detailed characteristics of the dispersion in these statistical results are determined by the detailed characteristics of the Hamiltonian and the model space, we find that overall the dispersion decreases inversely as the square root of the dimension of the model space. This is in keeping with results obtained earlier for the Hamiltonian moments of nuclear systems and means, speaking broadly, the larger the problem the more accurate the method.

46442 **Lithium 1s main-line and satellite photoemission: Resonant and nonresonant behavior.** Ferrett, T.A.; Lindle, D.W.; Heimann, P.A.; Brewer, W.D.; Becker, U.; Kerkhoff, H.G.; Shirley, D.A. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory 0 Department of Chemistry, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 7, 3172-3183(1 Oct 1987). Contract AC03-76SF00098.

We present experimental results on core-level photoemission of atomic lithium, leading to both main-line and satellite states of the Li^+ ion (1snl where n = 2—5). We compare the measured 1s2s /sup 1,3/S main-line cross sections with recent relaxed Hartree-Fock calculations and with previous experimental results, finding reasonable agreement in both cases. For the n = 3 satellite, our results disagree with earlier photoemission work which was complicated by additional peaks at 52 eV kinetic energy. We discuss possible explanations for these extra peaks. For the doubly excited state 1s(3s3p) at 71.14 eV, we present total cross-section results in good agreement with previous photoabsorption measurements. The qualitative differences among our partial cross-section profiles are discussed, and the phase for the total cross section is rationalized by estimating the signs of pertinent matrix elements.

46443 **Emission-line profiles of helium autoionization states after excitation by fast Li and He ions.** Arcuni, P.W.; Schneider, D. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 7, 3059-3070(1 Oct 1987).

We report the angle-dependent electron emission from the $(2s^2)\ ^1S$, $(2s2p)\ ^1P$, and $(2p^2)\ ^1D$ autoionizing states of helium, after excitation by 100-keV/amu Li^+, Li/sup 2+/, and 500-keV/amu He^+, He/sup 2+/, Li^{+} Li/sup 2+/, and Li/sup 3+/ ions. All of the peak profiles are strongly affected by the electron-ion interaction that occurs after ionization. A method that accounts for this post-collision interaction, and allows comparison with theoretical calculations, is presented, and some previously unexplained discrepancies between theoretical and experimental line profiles are resolved. The differently charged ions cause systematic changes in the observed line profiles. We report some projectile-charge-dependent emission intensities for the different peaks. Accurate energy differences between the excited states are reported.

46444 **State changing in collisions of Rb(ns) Rydberg atoms with HF.** Kalamarides, A.; Goeller, L.N.; Smith, K.A.; Dunning, F.B.; Kimura, M.; Lane, N.F. (Department of Space Physics and Astronomy, Department of Physics and the Rice Quantum Institute, Rice University, P.O. Box 1892, Houston, Texas 77251). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 7, 3108-3112(1 Oct 1987).

Rate constants for state changing in collisions of Rb(ns) Rydberg atoms ($40 \leqq n \leqq 48$) with HF molecules have been measured and have been calculated using a semiclassical approach. Agreement between the total rate constants measured experimentally and derived theoretically is very good. The results point to the near-resonant nature of n-changing collisions, but indicate that the rate constants for such reactions are less dependent on energy imbalance than suggested by calculations based on the impulse approximation.

46445 **Resonance enhancement of electron collision rates for fluorinelike ions.** Reed, K.J.; Chen, M.H.; Hazi, A.U. (High Temperature Physics Division, University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 7, 3117-3124(1 Oct 1987). Contract W-7405-ENG-48.

The distorted-wave approximation and similar weak-coupling methods are frequently used to calculate electron collision cross sections for studies of astrophysical and laboratory plasmas. Autoionizing resonances neglected in these approximations can significantly enhance the calculated rates for collisional excitation of some transitions in highly charged ions. We investigated the effects of such resonances on the excitation rates for n = 2 to n = 2 transitions in fluorinelike Fe, Se, Mo, Ag, Xe, and Eu. The background excitation rates were calculated using a relativistic distorted-wave approximation, and the detailed Auger and radiative rates were calculated using a multiconfiguration Dirac-Fock model. The largest effect is on the electric-dipole-forbidden transitions. The enhancement diminishes with increasing atomic number for all transitions.

46446 **Time-dependent Hartree-Fock theory of multiphoton ionization: Helium.** Kulander, K.C. (Theoretical Atomic and Molecular Physics Group, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 6, 2726-2738(15 Sep 1987).

The multiphoton ionization of helium has been determined for a number of laser wavelengths and intensities using the time-dependent Hartree-Fock model. Conclusions about the ionization dynamics for very-short-pulse, high-intensity lasers are discussed. The limits and characteristics of the time-dependent Hartree-Fock method for atomic physics processes are also evaluated.

46447 **Role of atomic resonances in the ionization of potassium atoms in slow collisions with He(2 /sup 1,3/S).** Scheibner, K.F.; Cohen, J.S.; Martin, R.L.; Lane, N.F. (Theoretical Atomic and Molecular Physics Group, Physics Department, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 6, 2633-2642(15 Sep 1987).

Cross sections have been calculated for the Penning ionization of ground-state potassium atoms in collisions with metastable He(2 /sup 1,3/S) atoms for the range of center-of-mass-system energies $0.01\ eV \leqq E \leqq 1.0\ eV$. The cross sections were calculated using ab initio ptical potentials. The real part of the optical potential was obtained by adjusting the potential curve resulting from a configuration-interaction (CI) calculation performed on the HeK molecule so as to include the correct van der Waals asymptotic form. The imaginary part was obtained by performing a Stieltjes moment analysis of a discrete (L^2) representation of the $HeK^+ + e^-$ continuum generated in a CI procedure. The calculated cross section for He(2 ^3S) scattered from K at E = 0.032 eV is in good agreement with stationary afterglow measurements at room temperature. A nearly degenerate core-excited state of potassium [which has a curve crossing with the He(2 ^3S)K molecular state] is then explicitly included in a Landau-Zener formulation which further increases the calculated cross section, but it still agrees well with the room-temperature measurements. Elastic differential cross sections for He(2 ^1S) on K are also reported.

46448 **Energy levels of neutral and singly ionized berkelium, /sup 249/Bk I and II.** Worden, E.F.; Conway, J.G.; Blaise, J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* **4**: No. 9, 1358-1368(Sep 1987). Contract W-7405-ENG-48.

Energy-level analyses of the observed emission spectrum of berkelium have yielded 179 odd and 186 even levels of neutral berkelium Bk I, and 42 odd and 117 even levels of singly ionized berkelium Bk II. The levels are tabulated with the J value, the g value, the configuration and hyperfine constants A and B, and the width given for many of the levels. The ground states of Bk I and Bk II are [Rn]5f^{9}7s^2 ^{6}H^o/sub 15/2/ and [Rn]5f^{9}7s ^{7}H$^o_8$, respectively. A table lists the lowest level of each identified electronic configuration of Bk I and Bk II.

46449 Time-resolved measurements of short-wavelength fluorescence from x-ray-excited ions. Kapteyn, H.C.; Murnane, M.M.; Falcone, R.W. (Department of Physics, University of California, Berkeley, Berkeley, California 94720). *Optics Letters;* **12**: No. 9, 663-665(Sep 1987).

We demonstrate a novel technique for time-resolved spectroscopic studies of highly excited ions. The technique uses a laser-produced plasma as a short-pulse, soft-x-ray light source with a high repetition rate. A Nd:YAG laser with a pulse duration of 90 psec, a pulse energy of 70μJ, and repetition rate of 10^4 pulses per second is focused onto a rotating metal target. Soft x rays from the resulting plasma photoionize a gas surrounding the target, and fluorescence from the gas is detected by using a spectrometer and a high-speed photodetector. Using the technique of time-correlated photon counting, we determined the radiative lifetime and collisional quenching rate of the Xe III 5s^{4}5p^6 ^{1}S$_0$ state by observing its fluorescence at 108.9 nm. A time resolution of better than 400 psec was obtained. We also measured relative Auger decay yields of a core hole state in xenon using a higher-energy laser-produced plasma light source at a lower repetition rate.

46450 Efficient two-photon-resonant frequency conversion in mercury: the effects of amplified spontaneous emission. Smith, A.V.; Hadley, G.R.; Esherick, P.; Alford, W.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Optics Letters;* **12**: No. 9, 708-710(Sep 1987). Contract AC04-76DP00789.

Numerical modeling of two-photon-resonant sum-frequency mixing in mercury vapor predicts efficiencies >10% for generation of 130.2-nm oxygen resonance light. The modeling indicates that power broadening of the two-photon resonance due to amplified spontaneous emission from the pumped level strongly influences the mixing process. Measurements of the broadening and the efficiencies for difference-frequency mixing are presented as a check of the model calculations.

46451 High brightness ion source: The Penning ringatron. Whealton, J.H.; Stirling, W.L.; Ryan, P.M.; Akerman, M.A.; Becraft, W.R.; Gardner, W.L.; Haselton, H.H.; Rothe, K.E.; Bell, M.A.; Raridon, R.J.; and others. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 404-418(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The design of a high brightness penning ion source is discussed. A cylindrical configuration (RINGATRON) is used. This is shown to improve ion extraction across the magnetic field. It also leads to enhanced production density. Comparisons of the ringatron configuration with the duoplasmatron and the planar penning discharge configuration are made. (AIP)

46452 Transverse-field focussing beam transport experiment. Kwan, J.W.; Ackerman, G.D.; Anderson, O.A.; Chan, C.F.; Cooper, W.S.; Soroka, L.; Steele, W.F. (LBL-22387, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 507-517(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The Transverse-Field Focussing (TFF) beam transport and accelerator system developed at LBL is useful for negative-ion-based neutral beam injection due to its unique differential pumping and neutron shielding properties. We have tested the first module of our TFF system transporting H^- beams up to 80 keV beam energy. The testing addressed the most crucial physics and engineering issues involved in the principles of a TFF system including beam compression and differential gas pumping. At optimum perveance, the present design will transport 4 A/m of H^- beam at 80 keV beam energy.

46453 Panel session: Transport of negative ion beams. Allison P. (moderator); Holmes, A.J.T.; Lietzke, A.F.; Whealton, J.H.; Wright, L. (LBL-22387, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 520-533(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Transport of negative ion beams through plasma is reviewed. The effect of space charge on beam stability and beam emittance is discussed. The approaches to the beam transport problem developed at Los Alamos, Berkeley, Oak Ridge and Culham Laboratory are intercompared. (AIP)

46454 Fundamental processes in low energy collisions of alkali anions and atoms. Champion, R.L.; Doverspike, L.D.; Scott, D.M.; Wang, Y. (Department of Physics, College of William and Mary Williamsburg, VA 23185). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 536-546(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A summary of observations of collisions of alkali ions with atoms and molecules and collisions of H^- and D^- with alkali atoms is presented. The energy range of the experiments was $5<E<500$ eV. Results on cross sections for collisional electron detachment and charge transfer of negative ions are discussed. (AIP)

46455 High-charge-state plasma neutralizer for an energetic H^- beam. Schlachter, A.S.; Leung, K.N.; Stearns, J.W.; Olson, R.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 631-642(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A high-charge-state plasma neutralizer for a beam of energetic H^- ions offers the potential of high optimum neutralization efficiency (—85%) relative to a gas target (50—60%), and considerably reduced target thickness. We have calculated cross sections for charge-changing interactions of fast H^- and H^0 in collision with highly charged ions using a semiclassical model for H^-, and the Classical-Trajectory Monte Carlo method plus Born calculations, to obtain correct asymptotic cross sections in the high-energy limit. Charge-state fractions as a function of plasma line density, and f / sup max/$_0$, the maximum H^0 fraction, are calculated using these cross sections; we find that f /sup max/$_0\cong$85% for ion charge states in the range 1+ to 10+, and that target ion line density for f /sup max/$_0$ decreases approximately as the square of the plasma ion charge state. The maximum neutral fraction is also high for a partially ionized plasma. We have built a small multicusp plasma generator to use as a plasma neutralizer; preliminary results show that the plasma contains argon ions with an average charge state between 2+ and 3+ for a steady-state discharge.

46456 Measurement of plasma production and neutralization in gas neutralizers. Maor, D.; Meron, M.; Johnson, B.M.; Jones, K.W.; Agagu, A.; Hu, B. (Brookhaven National Laboratory, Upton, NY 11973). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 643-650(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A proposed experiment is described. The aim is to measure cross sections for the charge exchange of H^-, H^0, H^+ projectiles, as well as the cross sections of ion production in the target. Experiments will be performed on many gases to measure differences in neutralization efficiency and plasma production. (AIP)

46457 **Oscillations in photodetachment cross sections for ions in magnetic fields.** Crawford, O.H. (Health and Safety Research Division, Oak Ridge national Laboratory, Oak Ridge, Tennessee 37831-6123). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 663-672(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The photodetachment cross section of a charged particle bound in a short range potential is an oscillating function of frequency of incident light, in the presence of a magnetic field. The theory of this effect is described, and calculated cross sections are shown. For photodetachment of electrons from negative atomic ions, this constitutes an additional magnetic field effect beyond the ones associated with fine and hyperfine structure of the ion and atom and with spin of the detached electron.

46458 **Novel high-resolution experimental approach for studying laser photodetachment in a magnetic field.** Krause, H.F. (Oak Ridge National Laboratory, Oak Ridge, TN 37831). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 673-681(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The need for new high-resolution photodetachment data is discussed. An E-arrow-right x B-arrow-right photoneutralizer concept that is capable of achieving the resolution required for spectroscopic studies is described. Feasibility of the concept has been evaluated in Monte carlo trajectory studies. The calculations indicate that spectral resolutions in the range 300—30 MHz are achievable in a five-parameter coincidence experiment. These bandwidths are 20 to 200 times narrower than have been achieved heretofore in experiments that used the Penning trap technique. Stray electric fields in the E-arrow-right x B-breve photoneutralizer also are much smaller than those in a trap ($<1/20$). The improved apparatus resolution should allow Landau resonances to be studied at magnetic field strengths well below those used previously.

46459 **Ion-X-ray coincidence measurements in heavy ion collisions.** Graham, W.G.; Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Berkner, K.H.; Schlachter, A.S.; Stearns, J.W.; Johnson, B.M.; Jones, K.W.; Meron, M. (Ulster Univ., Coleraine, England; Western Michigan Univ., Kalamazoo; Lawrence Berkeley Lab., CA; Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 69-73(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

X-ray emission associated with projectile charge-changing events in fast ion-atom collisions can be used to isolate and investigate excitation, ionization and charge transfer, as well as combinations of these processes. The major emphasis to date has been on the study of two-electron processes. Several such processes have been studied in detail. Resonant and nonresonant transfer and excitation (RTE and NTE) occur when electron capture and projectile excitation, with stabilization by X-ray emission, take place together in a single collision. Loss and excitation (LE) occurs when a projectile electron is removed and the ion is excited in a single collision. The cross sections for loss and excitation have been measured for a wide range of highle stripped projectiles over a broad energy range. The results shed light on projectile K X-ray production processes in heavy-ion collisions. The use of ion X-ray coincidence techniques in exploring these and other collision processes will be discussed.

46460 **Ionization and charge transfer in high-energy ion-atom collisions.** Schlachter, A.S.; Berkner, K.H.; Stearns, J.W.; Graham, W.G.; Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Schmidt-Boecking, H.; Kelbch, S.; Ullrich, J. (Lawrence Berkeley Lab., CA; Ulster Univ., Coleraine, England; Western Michigan Univ., Kalamazoo; Frankfurt Univ., Germany, F.R.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 219-223(Apr 1987). (CONF-861114—). Contract AC03-76SF00098;AC02-83ER13116.

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Electron capture and loss by fast highly charged ions in a gas target, and ionization of the target by passage of the fast projectile beam, are fundamental processes in atomic physics. These processes, along with excitation, can be exerimentally studied separately (singles) or together (coincidence). This paper is a review of recent results on singles measurements for electron capture and loss and for target ionization, for velocities which are generally high relative to the active electron, including recent ionization measurements for a nearly relativistiv projectile.

46461 **Simple formula for the energies of doubly excited states.** Lin Chiidong; Watanabe, S. (Argonne National Lab., IL; Observatoire de Paris, France). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 284-287(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A simple formula for the energy levels of doubly excited states of atoms and multiply charged ions is derived and expressed in terms of a set of new correlation quantum numbers. The accuracy of the formula is checked by comparing with the results from other elaborate calculations. Modification of the formula for doubly excited states of multielectron atoms are also presented.

46462 **Autodetachment spectroscopy of metastable negative ions.** Kvale, T.J.; Alton, G.D.; Compton, R.N.; Thompson, J.S.; Pegg, D.J. (Oak Ridge National Lab., TN; Tennessee Univ., Knoxville). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 325-328(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

This paper is a review of some of our recent measurements on the metastable negative ions, Be^- and He_2^-, using the technique of fast-beam autodetachment spectroscopy.

46463 **Remarks about fields of high intensity.** Teller, E. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 1-2(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

At high field strength any known material will break down by the production of electrons and ions. At a higher field strength, massive production of pairs will occur. This phenomenon is discussed when heavy ions of $\gamma \approx 100$ collide. Even when the heavy ions approach to within one nuclear radius, pair production involving electrons and mesons must be expected. High magnetic fields between the nuclei might be coupled to pairs of magnetic monopoles.

46464 **Atomic physics experiments with stored cooled heavy ion beams.** Datz, S. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 3-10(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The wide ranging interest in the development of heavy ion synchrotrons with electron beam cooling is evident from the

number of projects presently under way. Although much of the initial motivation for these rings stemmed from nuclear and particle physics, a considerable amount of atomic physics experimentation is planned. This paper surveys some of the new opportunities in atomic physics which may be made available with storage ring systems.

46465 **Electron capture in ion-molecule collisions at intermediate energy.** Kimura, M. (Argonne National Lab., IL; Rice Univ., Houston, TX). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 101-105(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Recent progress in theoretical studies on charge transfer in ion-molecule collisions at the intermediate energy is reviewed. Distinction between close and distant collisions is crucial to the understanding of charge transfer processes, as it is in many aspects of ion-atom collisions. For a close collision, explicit representation of the whole collision complex is necessary to describe the collision dynamics correctly, while a model potential approach for the molecule is appropriate for a distant collision. It is shown that these two distinct points of view are necessary for reproducing experimental charge transfer cross sections. Some remarks concerning further theoretical study of ion-molecule collisions are also given.

46466 **Evidence for correlated double-electron capture in slow collisions of multicharged ions with He and H_2.** Meyer, F.W.; Havener, C.C.; Phaneuf, R.A.; Swenson, J.K.; Shafroth, S.M.; Stolterfoht, N. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 106-110(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report CONF-861114—14–6.

High resolution measurements of the production of $L_1L_{23}X$ Coster-Kronig and LMX-Auger electrons in slow collisions of C^{4+}, N^{5+}, O^{6+}, and O^{7+} with He and H_2 have been performed, using the method of 0° Auger spectroscopy. For the latter three projectiles, strong Coster-Kronig lines are observed, which are attributed to the configurations (core)2pnl, produced by double-electron capture. It is argued that production of these nonequivalent electron configurations must involve electron-electron correlation. From a comparison of the production cross sections for these Coster-Kronig electrons and the LMX-Auger electrons, it is further argued that correlation plays a significant role in two-electron transfer processes.

46467 **Surgery of fast, highly charged ions studied by zero-degree Auger spectroscopy.** Stolterfoht, N.; Miller, P.D.; Krause, H.F.; Yamazaki, Y.; Swenson, J.K.; Bruch, R.; Dittner, P.F.; Pepmiller, P.L.; Datz, S. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 168-172(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Zero-degree Auger spectra were measured for the projectile in collisions of oxygen and carbon on He with incident charge states of q=2-5 and for energies from 5 to 30 MeV. Since the light target particle He acts selectively on the projectile ion, we refer to the present method as ion sugery. Apart from the one-electron processes of single excitation and single loss, two-electron processes such as transfer excitation and transfer loss are studied.

46468 **Recent studies of simultaneous ionization and charge transfer in helium ion-atom collisions.** DuBois, R.D. (Battelle Pacific Northwest Labs., Richland, WA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 209-213(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

In our laboratory, we are interested in ionization of atomic and molecular targets induced by light ion impact. Generally these collisions are studied by monitoring the ejected electron spectra with the assumption that each ionizing event leads to a single secondary electron. By measuring the target ionization charge states produced by directly ionizing and charge changing collisions, we have obtained cross sections for direct ionization, pure charge transfer, and charge transfer plus ionization thus making it possible to distinguish how target ionization occurs. It was found that charge transfer plus ionization can sometimes be more probable than pure charge transfer alone. This is important because one mechanism which has until recently been disregarded as a means of producing free electrons is the possibility of capturing an electron from the target and simultaneously ionizing one or more target electrons. For ion impact velocities comparable to, or less than, the outer shell bound electron velocities, we have found that charge transfer plus ionization can be a substantial, if not principal, means of producing free electrons.

46469 **Measured multipole moments of continuum electron transfer angular distributions.** Elston, S.B. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 214-218(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The velocity space distribution of electrons emitted near the forward direction from collisions involving fast, highly stripped oxygen ions with gaseous and solid targets is presented and described in terms of multipole moments of the ejected charge distribution, which permits direct comparison with recent theory. The measurements are produced by employing position-sensitive electron detection to combine emission angle definition with conventional electrostatic spectrometry. Agreement obtained between theory and distributions observed for binary continuum electron loss processes coupled with a similar multipole content observed with solid targets suggests a model of convoy electron production dominated by electron loss from the projectile within the bulk of the target. Further, the connection between multipoles of the projectile electron emission distribution in single collisions and the state of excitation of that projectile excited states may provide the basis for a probe of the state of ions traversing bulk solid mattter.

46470 **Calculations of coincident ionization plus excitation.** Becker, R.L. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 256-260(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

For Li- nd Be-like ions, K X-ray yields, together with detection that the ionic charge has increased, give the cross section for ionization plus excitation (IE), a process which can exhibit electron-electron correlations. Measurements of IE for $_{14}Si^{11+}$ + He stimulated our coupled-channels calculations in the independent-Fermi-particle model (IFPM), which includes Pauli correlations. We discuss how the IFPM expressions, generalized here to include an open shell, differ from those for distinguishable electrons. The sensitivity of σ/sub IE/ to correlations is shown. Recent additional measurements and future ones giving excitation functions for resolved configurations and complementary Auger data will provide even more sensitive tests of collisional correlation theory.

46471 **Angular distributions of very low energy recoil ions.** Gonzalez Lepera, C.E.; Breinig, M.; Burgdoerfer, J.; DeSerio, R.; Elston, S.B.; Gibbons, J.P.; Huelskoetter, H.P.; Liljeby, L.; Short, R.T.; Vane, C.R. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 316-320(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

We present the first measurements of the angular distribution of recoil ions near 90° with respect to the incident projectile direction. Beams of 22.5 and 33 MeV chlorine ions (incident charge states q = 4, 5, 8) have been used as hammer beams incident on Ne

atoms. We do not confirm the long standing assumption that these recoil ions are ejected preferentially at angles very near 90° with respect to the primary beam direction, although they do have energies typically less than 5 eV. Recoil ions ejected around 90° have an energy distribution appreciably wider than those ejected at either larger or smaller angles.

46472 **Ion-X-ray coincidence measurements in heavy ion collisions.** Graham, W.G.; Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Berkner, K.H.; Schlachter, A.S.; Stearns, J.W.; Johnson, B.M.; Jones, K.W.; Meron, M. (Ulster Univ., Coleraine, England; Western Michigan Univ., Kalamazoo; Lawrence Berkeley Lab., CA; Brookhaven National Lab., Upton, NY). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 69-73(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

X-ray emission associated with projectile charge-changing events in fast ion-atom collisions can be used to isolate and investigate excitation, ionization and charge transfer, as well as combinations of these processes. The major emphasis to date has been on the study of two-electron processes. Several such processes have been studied in detail. Resonant and nonresonant transfer and excitation (RTE and NTE) occur when electron capture and projectile excitation, with stabilization by X-ray emission, take place together in a single collision. Loss and excitation (LE) occurs when a projectile electron is removed and the ion is excited in a single collision. The cross sections for loss and excitation have been measured for a wide range of highle stripped projectiles over a broad energy range. The results shed light on projectile K X-ray production processes in heavy-ion collisions. The use of ion X-ray coincidence techniques in exploring these and other collision processes will be discussed.

46473 **Ionization and charge transfer in high-energy ion-atom collisions.** Schlachter, A.S.; Berkner, K.H.; Stearns, J.W.; Graham, W.G.; Bernstein, E.M.; Clark, M.W.; Tanis, J.A.; Schmidt-Boecking, H.; Kelbch, S.; Ullrich, J. (Lawrence Berkeley Lab., CA; Ulster Univ., Coleraine, England; Western Michigan Univ., Kalamazoo; Frankfurt Univ., Germany, F.R.). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 219-223(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Electron capture and loss by fast highly charged ions in a gas target, and ionization of the target by passage of the fast projectile beam, are fundamental processes in atomic physics. These processes, along with excitation, can be exerimentally studied separately (singles) or together (coincidence). This paper is a review of recent results on singles measurements for electron capture and loss and for target ionization, for velocities which are generally high relative to the active electron, including recent ionization measurements for a nearly relativistiv projectile.

46474 **Production and neutralization of negative ions and beams.** Alessi, J.G. (ed.). New York, NY; American Institute of Physics (1987). 774p. (CONF-8610115—). Series Editor, AIP Conference Proceedings, American Institute of Physics, 335 E. 45th St., New York, NY 10017 $72.50. File Number TI87014224. Contract AC02-76CH00016.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

Contained in this book are a collection of papers from the conference proceedings on the production and neutralization of negative ions and beams. Papers are grouped together in the following areas: fundamental processes, source diagnostics, H^- sources, H^- production and beam formation, transport of negative ion beams, production of other negative ions, neutralization, and systems and applications. (LSP)

46475 **Tau electron atoms at RHIC.** Weiss, M.S. (Physics Dept., Lawrence Livermore National Lab., Livermore, CA 94550). pp 769-780 of Phase space approach to nuclear dynamics. Di Toro, M.; Norenberg, W.; Rosina, M.; Stringari, S. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8509227—).

From IAEA topical meeting on phase space approach to nuclear dynamics; Trieste, Italy (30 Sep 1985).

An amusement ancillary to the proposed quark-gluon plasma production hypothesized from a relativistic heavy ion collider (RHIC is a sufficient quantity of tau electrons to potentially admit the study of its exotic atoms. In this paper the given wealth of nuclear phenomena is derived from muonic atoms assume a tau atom is more forthcoming of information due to the lower orbits entirely contained within the nucleus. It is the purpose of this brief note to discuss the production mechanism at a RHIC and to delineate some of the more obvious properties of the tau atom. As in the case of the mu, more exotic phenomena derived from resonance "accidents" with nuclear transitions takes place, but it would be presumptions to discuss them at this time. Given the complete containment in nuclear matter of the tau lepton in its innermost atomic orbits. An experiment performed with such an exotic species results in the measurement of its lifetime.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 46837, 46850, 46851, 46998

46476 **(DOE/ER/25009—424) Dynamical grid optimization for Lagrangian hydrodynamics.** Williams, R.D. (California Inst. of Tech., Pasadena (USA)). 1985. Contract FG03-85ER25009. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013499.

Lagrangian hydrodynamics exchanges the difficulty of convective derivatives for the difficulty of a mesh whose vertices move with the fluid. To prevent numerical instability, the mesh must be continually restructured to optimize the condition number of its stiffness matrix. This optimization problem is further complicated because the restructuring itself introduces undesirable numerical diffusion; we must try to find a good mesh with the fewest possible moves. I report the implementation of an algorithm for dynamical optimization of a triangular mesh using three elementary operations, and give various measures of its performance. I also discuss the extension of these methods to distributed memory parallel computers, where a dynamical load-balancer could be introduced as a fourth restructuring operation.

46477 **(LA-UR—87-1627) Dimension densities for turbulent systems with spatially decaying correlation functions.** Mayer-Kress, G.; Kurz, T. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 11p. (CONF-8610281—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010119.

From Modern approaches to large nonlinear physical systems workshop; Santa Fe, NM, USA (27 Oct 1986).

The introduction of nonlinear, deterministic, and low-dimensional dynamical systems with chaotic solutions led to many conjectures about how these chaotic systems might be related to fluid turbulence. It appears that the time series, produced by a chaotic solution can be as complex as experimentally observed signals from turbulent hydrodynamics. Furthermore, certain transitions from laminar to turbulent flow have their analog in the transition from ordered to chaotic behavior of deterministic chaotic systems. A basic problem in this context is how far methods from nonlinear dynamical systems can be used to describe experimental turbulence. A frequent objection to the approach of using simple dynamical systems as models for turbulence is that these models might reproduce some temporal chaos but would not correspond to real turbulence, for which the spatial structure also is very irregular and chaotic. The dynamics of a turbulent flow are not expected to be spatially coherent and therefore cannot be described by a few global modes. In the following we use the simplest of coupled maps in order to test the applicability of some ideas which should make it possible to estimate the number of degrees of freedom per unit length of a system which is spatially incoherent. This is done by

computing the dimension density of the lattice system through a series of two-point measurements at separated lattice points. Then we compare these results with the spatial decay of the correlation function and also of the mutual information content. We find a qualitative agreement with the expected dependence. For precise quantitative measurements the general problem of accuracy and data limitations appear to become dominant.

46478 **(LA-UR—87-1862) PIC [Particle-in-Cell] and its progeny.** Harlow, F.H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 17p. (CONF-8704168—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011794.

From Workshop on particle methods in fluid dynamics and plasma physics; Los Alamos, NM, USA (13 Apr 1987).

The Particle-in-Cell (PIC) method was developed to solve numerically for the strongly contorting dynamics of several materials in two or three space dimensions. Related numerical techniques with Lagrangian marker particles are also discussed in this brief survey. An extensive bibliography lists many of the earlier publications describing these techniques.

46479 **(LA-UR—87-2524) Lattice gas hydrodynamics in two and three dimensions.** Frisch, U.; d'Humieres, D.; Hasslacher, B.; Lallemand, P.; Pomeau, Y.; Rivet, J.P. (Los Alamos National Lab., NM (USA); Observatoire de Nice, 06 (France); SEE CODE- 2271000 Ecole Normale Superieure, 75 - Paris (France). Lab. de Physique). 1986. Contract W-7405-ENG-36. 56p. (CONF-8610281—2). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013167.

From Modern approaches to large nonlinear physical systems workshop; Santa Fe, NM, USA (27 Oct 1986).

Hydrodynamical phenomena can be simulated by discrete lattice gas models obeing cellular automata rules (U. Frisch, B. Hasslacher, and Y. Pomeau, Phys. Rev. Lett. 56, 1505, (1986); D. d'Humieres, P. Lallemand, and U. Frisch, Europhys. Lett. 2, 291, (1986)). It is here shown for a class of D-dimensional lattice gas models how the macrodynamical (large-scale) equations for the densities of microscopically conserved quantities can be systematically derived from the underlying exact "microdynamical" Boolean equations. With suitable restrictions on the crystallographic symmetries of the lattice and after proper limits are taken, various standard fluid dynamical equations are obtained, including the incompressible Navier-Stokes equations in two and three dimensions. The transport coefficients appearing in the macrodynamical equations are obtained using variants of fluctuation-dissipation and Boltzmann formalisms adapted to fully discrete situations.

46480 **(LA-UR—87-2554) Phase dynamics: A review and a perspective.** Brand, H.R. (Los Alamos National Lab., NM (USA); Essen Univ. (Gesamthochschule) (Germany, F.R.)). 1987. Contract W-7405-ENG-36. 33p. (CONF-8703165—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013173.

From Workshop on propagative nonequilibrium patterns; Les Houches, France (1 Mar 1987).

The present status of phase dynamics, the analogue of hydrodynamics for large aspect-ratio pattern forming non-equilibrium systems has been reviewed. Low frequency, long wavelength excitations in systems such as the regular patterns which arise in the Taylor instability (a simple fluid in the gap between two concentric cylinders was subjected to a torque by rotating the inner or both cylinders) or the Benard instability (a thin layer of fluid heated from below) has been examined and the question of nonlinear excitations such as solitary waves addressed. The connection between the phenomenological parameters arising in the phase equations and results obtained from amplitude equations valid close to the onset of a specific pattern were investigated. Suggestions for experiments to test further the concept of phase dynamics have also been included.

46481 **(UCRL—96835) Locating parallel numerical tasks in the solution of viscous fluid flows.** Rodrigue, G.; Perkins, A.L. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). 14 Jul 1987. Contract W-7405-ENG-48. 20p. (CONF-8706181—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013510.

From 4. Deutsche Forschungs-und Verschesanstalt Fur Fult- und Raumfahart conference; Koln, F.R. Germany (25 Jun 1987).

A parallel processing technique is presented for the two dimensional heat equation. The solution is considered for a small time interval with an initial condition that possesses a sharp gradient.

46482 **Stability and bifurcation of a rotating planar liquid drop.** Lewis, D.; Marsden, J.; Ratiu, T. (Department of Mathematics, University of California, Berkeley, California 94720). *Journal of Mathematical Physics (New York);* **28**: No. 10, 2508-2515(Oct 1987).

The stability and symmetry breaking bifurcation of a planar liquid drop is studied using the energy-Casimir method and singularity theory. It is shown that a rigidly rotating circular drop of radius r with surface tension coefficient tau and angular velocity $\Omega/2$ is stable if $(\Omega/2)^2 < 3\text{tau}/r^3$. A new branch of stable rigidly rotating relative equilibria invariant under rotation through π and reflection across two axes bifurcates from the branch of circular solutions when $(\Omega/2)^2 = 3\text{tau}/r^3$.

46483 **Cusp map in the complex-frequency plane for absolute instabilities.** Kupfer, K.; Bers, A.; Ram, A.K. (Research Laboratory of Electronics and Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **30**: No. 10, 3075-3082(Oct 1987).

It is well known that absolute instabilities can be located by prescribed mappings from the complex-frequency plane to the wavenumber plane through the dispersion relation $D(\omega,k) = 0$. However, in many systems of physical interest the dispersion relation is polynomial in ω while transcendental in k, and the implementation of this mapping procedure is particularly difficult. If one maps consecutive deformations of the Fourier integral path (originally along the real k axis) into the ω plane, points having (partialD/partialk) = 0 are readily detected by the distinctive feature of their local maps. It is shown that a simple topological relationship between these points and the image of the real k axis determines the stability characteristics of the system, without mapping from the ω plane back into the k-plane.

46484 **Long-wave instability of periodic flows at large Reynolds numbers.** Libin, A.; Sivashinsky, G.; Levich, E. (Department of Mathematical Sciences, Tel Aviv University, Ramat Aviv, Tel Aviv 69978, Israel). *Physics of Fluids;* **30**: No. 10, 2984-2986(Oct 1987).

It is shown that simple unidirectional and helical periodic flows are unstable to long-wave perturbations at large Reynolds numbers. Consideration is given to the cases of periodic flow sustained by an applied force and periodic flow freely decaying owing to viscosity.

46485 **Pressure gradient alignment with strain rate and scalar gradient in simulated Navier—Stokes turbulence.** Ashurst, W.T.; Chen, J.; Rogers, M.M. (Combustion Research Facility, Sandia National Laboratory, Livermore, California 94550). *Physics of Fluids;* **30**: No. 10, 3293-3294(Oct 1987).

In a simulated turbulent shear flow the pressure gradient caused by velocity fluctuations alone has increased probability for alignment with the most compressive strain direction, which is similar to passive scalar-gradient behavior. The pressure-gradient component depending on the mean shear indicates no correlation with the strain directions.

46486 **Errors for calculations of strong shocks using an artificial viscosity and an artificial heat flux.** Noh, W.F. (Lawrence Livermore National Laboratory, P.O. Box 808, University of California, Livermore, California 94550). *Journal of Computational Physics;* **72**: No. 1, 78-120(Sep 1987). Contract W-7405-ENG-48.

The artificial viscosity (Q) method of von Neumann and Richtmyer is a tremendously useful numerical technique for following shocks wherever and whenever they appear in the flow. We show that it must be used with some caution, however, as serious Q-induced errors (on the order of 100%) can occur in some strong

shock calculations. We investigate three types of Q errors: 1. Excess Q heating, of which there are two types: (a) excess wall heating on shock formation and (b) shockless Q heating; 2. Q errors when shocks are propagated over a nonuniform mesh; and 3. Q errors in propagating shocks in spherical geometry. As a basis of comparison, we use as our standard the Lagrangian formulation with Q = C²₀rhol²(u/sub x/)². This standard Q is compared with Noh's (Q & H) shock-following method, which employs an artificial heat flux (H) in addition to Q, and with the (non-Q) piecewise-parabolic method (PPM) of Colella and Woodward. Both the (Q & H) method and PPM (particularly when used with an adaptive shock-tracking mesh) give superior results for our test problems. In spherical geometry, Schulz's and Walen's tensor Q formulations of the hydrodynamic equations prove to be more accurate than the standard Q formulation, and when Schulz's formulation is combined with Noh's (Q & H) method, superior results are achieved. Copyright 1987 Academic Press, Inc.

46487 **Fluid modeling of magnetized plasmas.** Brackbill, J. (Los Alamos National Lab., NM). *Space Science Reviews;* **42**: 153-167(1985).

The simplified description given by fluid models of magnetized plasmas makes it possible to simulate large scale problems such as the interaction of the solar wind with the earth's magnetic field. However, the accurate numerical solution of the fluid equations is made more difficult by the singular nature of the flow when magnetic reconnection occurs. During substorms, for example, details of small features of the flow in the magnetotail appear to cause changes in the global solutions. New methods for treating singular problems have been developed. Some of these are reviewed, including adaptive meshes and other tricks taken from fluid calculations. Several illustrative problems are described. 16 references, 6 figures.

6450 High Energy Physics

46488 **(DOE/ER/40319—1) [Research in elementary particle physics]: Progress report covering the period from August 1, 1986 to July 31, 1987.** (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1987. Contract FG05-87ER40319. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013902.

In this document the High Energy Physics Group reviews its accomplishments and progress during the past year and presents plans for continuing research during the next several years. Reviewed are the experimental programs such as the collider experiments, the particle theory programs such as vector boson production in supersymmetric QCD and miscellaneous program projects. (LSP)

46489 **Aspen Winter Physics Conference, 1st, Aspen, CO, Jan. 6-19, 1985, Proceedings.** Block, M.M. (Northwestern Univ., Evanston, IL). *Annals of the New York Academy of Sciences;* **461**: vp(Mar 1986). (CONF-850146—).

From Aspen winter physics conference; Aspen, CO, USA (14 Jan 1985).

The physics of ultrahigh-energy colliders and of electroweak interactions is explored in reviews and reports of theoretical and experimental investigations. Topics examined include high-energy multijets in hadron-hadron collisions, the top quark, heavy-quark production at the CERN proton-antiproton collider, multiplicities in high-energy interactions, and supergravity and superstrings. Consideration is given to cosmological constraints on particle physics, the LEP and SLC programs, precision measurements of the electroweak mixing angle, neutrino oscillation studies with reactor antineutrinos, proton decay, searches for magnetic monopoles, and electron-positron electroweak experiments.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 46065, 46575, 46575, 46578, 46581, 46591, 46596

46490 **(BNL—40139) Some recent results on meson spectroscopy.** Chung, S.U. (Brookhaven National Lab., Upton, NY (USA); Geneva Univ. (Switzerland). Dept. de Physique Nucleaire et Corpusculaire). 1 Jun 1987. Contract AC02-76CH00016. 13p. (CONF-870413—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014285.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

A comparative survey of established meson states with the predictions of a q anti q (quarkonium) model by Godfrey and Isgur shows that most meson states are well described, from pion to Y(6S). However, a number of states in the light- quark isoscalar sector are not predicted at all in their model, pointing to a need for glueballs, hybrids and multi-quark states to fully account for recently reported meson states. 48 refs.

46491 (BNL—52079, pp 15-24) **Neutrino oscillations at accelerators past results, future prospects.** Vannucci, F. (Universite Paris, France). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Are neutrinos massive? This is one of the most fundamental questions still facing physicists, which does not necessitate a new jump in energy. This answer is probably within reach of present machine. Among the various manifestations of massive neutrinos, oscillations are the most sensitive. They already test masses below the 1 eV level. Present results are summarized and future prospects outlined.

46492 (BNL—52079, pp 25-38) **Search for neutrino oscillations.** Astier, P. (LPNHE, Paris, France). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The present paper reports on preliminary results from the E 816 experiment at Brookhaven National Laboratory. E 816 is the continuation of a 1984 experiment (PS 191) which was devoted to a neutrino decay search in the CERN PS neutrino beam. No candidate was seen, but a study of neutrino interactions in the calorimeter indicated an anomalous electron production. The statistics was too low and the experiment has been rerun in spring 86 at BNL to look specifically, with an improved detector for nu/sub e/ arising from a low energy nu/sub μ/ beam. The results presented here are preliminary. This report starts with a description of the apparatus, followed by the data analysis. Questions are raised at the end concerning possible interpretations of their results which include many single nu/sub e/ events.

46493 (BNL—52079, pp 39-58) **Search for neutrino oscillations at the AGS with the narrow band beam.** Chi, C.; Kondakis, N.; Lee, W.; Rubin, B.; Seto, R.; Stoughton, C.; Tzanakos, G.; O'Brien, E.; O'Halloran, T.; Reardon, K.; Salman, S. (Columbia Univ., NY). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The authors have taken neutrino data with the NBB at BNL, in the summer and fall of 1985, and with the WBB in the spring of 1986. They are in the process of completing the analysis of the NBB data. In this paper they present preliminary results of this analysis. They observe an anomalous appearance of electron neutrinos above the expected background.

46494 (BNL—52079, pp 59-66) **Search for nu/sub μ/ → nu/sub e/ oscillations using the E734 detector.** Murtagh, M.J. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

No evidence for nu/sub μ/ $\rightarrow$ nu/sub e/ oscillations is observed in an experiment in the wide band beam at Brookhaven National Laboratory using the E734 neutrino detector. The 90% confidence level limits obtained are $\sin^2 2\alpha \leqq 3.4 \times 10^{-3}$ in the large mass difference limit and $\Delta m^2 \sin 2\alpha < 0.43 eV^2$ in the small mass difference limit.

46495 (BNL—52079, pp 67-76) **Neutrino oscillations in BEBC.** Baldo-Ceolin, M. (Dipartimento di Fisica dell'Universita, Padova, Italy). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

New experimental results on neutrino oscillations from experiments performed at the CERN PS using BEBC are presented. The experimental set up, event selection and data analysis are discussed. The flux of electron neutrinos detected was not in excess of that expected from background. Therefore the present data show no evidence for neutrino oscillation.

46496 (BNL—52079, pp 77-79) **Searches for neutrino oscillations.** Zacek, V. (CERN, Geneva, Switzerland). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Two searches for evidence of neutrino oscillation have been performed by the CHARM Collaboration looking for the appearance of nu/sub e/ in nu/sub μ/ beams. In the first one two similar detectors were exposed to the low-energy PS neutrino beam. This experiment was sensitive to small differences of the neutrino masses, and a limit of $\Delta m^2 \leqq 0.19 eV^2$ was obtained at 90% c.l. in the case of complete mixing. A second search was performed at the high-energy SPS neutrino beam. The higher statistics allowed sensitivity to mixing angles as low as sin^2theta = 0.005 (90% c.l.).

46497 (BNL—52079, pp 81-85) **Future long baseline nu/sub μ/ $\rightarrow$ nu/sub e/ oscillation searches at accelerators.** Murtagh, M.J. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The additional neutrino flux available when the Booster at the AGS becomes operational will make possible nu/sub μ/ $\rightarrow$ nu/sub e/ oscillation searches at Brookhaven which significantly extend beyond the present limits. Present nu/sub μ/ $\rightarrow$ nu/sub e/ oscillation searches at accelerators are limited by their L/E/sub nu/ range (0.1-1) to $\Delta m^2 \geqq 0.1 eV^2$ and $\sin^2 2\alpha \geqq 5 \times 10^{-3}$. It appears possible with the advent of the Booster to significantly improve the Δm^2 range to perhaps $\Delta m^2 \leqq 0.01 eV^2$ while maintaining reasonable $\sin^2 2\alpha$ coverage. However for a reasonable amount of Booster running ($\approx 10^{20}$ POT) with a modest detector (1 Kton fiducial volume), it will be difficult with distances greater than 10 Km to retain acceptable $\sin^2 2\alpha$ coverage.

46498 (BNL—52079, pp 187-194) **Elastic scattering of muon neutrinos at B.N.L.** Abe, K.; Ahrens, L.A.; Amako, K.; Aronson, S.H.; Beier, E.W.; Callas, J.L.; Cutts, D.; Diwan, M.; Durkin, L.S.; Gibbard, B.G.; Heagy, S.M. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

In this paper measurement of the purely leptonic reactions: nu/sub μ/e $\rightarrow$ nu/sub μ/e and anti nu/sub μ/e $\rightarrow$ anti nu/sub μ/e, and the semileptonic reactions: nu/sub μ/p $\rightarrow$ nu/sub μ/p are presented and discussed in terms of the standard model. The data also places limits of interest on the magnitudes of a possible neutrino charge radius and a neutrino magnetic moment. The data reported here were taken at the Brookhaven National Laboratory Alternate Gradient Synchrotron (A.G.S.) in a 170 ton, fine-grained target detector.

46499 (BNL—52079, pp 221-230) **Second class current effects in tau lepton decay?.** Derrick, M. (Argonne National Lab., IL). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—). Contract W-31-109-ENG-38.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The establishment of a second class current could be an indication of a so far unexplored Higgs sector and would be a major contribution to physics. Several searches for the effects of second class vector and axial vector currents in tau lepton decay are reviewed. Results from BNL, PEP, DORIS and the ARGUS collaboration are presented. Results to date are inconclusive but several groups are actively pursuing the issue.

46500 (BNL—52079, pp 233-247) **Summary and conclusions.** Merritt, F.S. (Univ. of Chicago, IL). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The author reviews some of the results presented at the workshop. He emphasizes systematic errors in the experiments and discusses ways of resolving discrepancies. Results considered include solar neutrino observations, CERN PS experiments and preliminary data from BNL experiments. He concludes with descriptions of two proposed future experiments: tagged neutrino experiments and long base line experiments.

46501 **(CONF-870797—1) Properties of e^+e^- interactions at $\sqrt{s}$ = 50 and 52 GeV.** (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jul 1987. Contract AS05-80ER10713. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014183.

From International symposium for lepton and photon interactions at high energy; Hamburg, F.R. Germany (27 Jul 1987).

Bhabha scattering and multi-hadronic e^+e^- annihilation events have been observed in the AMY detector at $\sqrt{s}$ = 50 GeV and $\sqrt{s}$ = 52 GeV at the TRISTAN e^+e^- storage ring. Here we report the results of a preliminary analysis of the properties of these events. We present results for the $e^+e^- \rightarrow e^+e^-$, $e^+e^- \rightarrow \gamma\gamma$ and $e^+e^- \rightarrow \mu^+\mu^-$ differential cross sections as well as for R, the ratio of e^+e^- annihilation into hadrons to that for dimuons. In addition we present results on the characteristics of the final state hadrons in the annihilation events.

46502 **(DOE/ER/03130—30) The determination of the weak neutral current coupling constants and limits on the electromagnetic properties of the muon neutrino.** Callas, J.L. (Brown Univ., Providence, RI (USA). Dept. of Physics). May 1987. Contract AC02-76ER03130. 139p. (COO—3130TC-30). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87014474.

The goal of this thesis is to determine experimentally the cross section for nu/sub μ/e $\rightarrow$ nu/sub μ/e scattering from a sample of over 100 expected nu/sub μ/e $\rightarrow$ nu/sub μ/e events collected by the E734 neutrino detector in BNL wide band neutrino beam. By combining these results with results from an anti-neutrino determination of the cross section for anti nu/sub μ/e $\rightarrow$ anti nu/sub μ/e scattering in the form of a ratio of cross sections, the weak coupling constants for the electron, g/sub V/ and g/sub A/ can be determined in a model independent way to within a four fold ambiguity where three of the ambiguities can be eliminated by results from e^+e^- experiments. The predictions of the Standard Model for the weak coupling constants can then be tested and a precise determination of the electroweak mixing parameter, $\sin^2 \theta$/sub W/ can be made.

46503 **(DOE/ER/03539—42) The search for neutrino oscillations in the appearance mode nu/sub μ/ $\rightarrow$ nu/sub e/ for neutrino energies near the muon threshold.** Huang, Ying-Chiang. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics). Dec 1986. Contract AC02-76ER03539. 235p. (COO—3539-42). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87013460.

To investigate the possibility of neutrino oscillation, a search for the exclusive mode, nu/sub μ/ → nu/sub e/, was performed at LAMPF. The reactions studied were nu/sub μ/ + C → μ^- + X; μ^- → e^- + anti nu/sub e/ + nu/sub μ/, and nu/sub e/ + C → e^- + X (if nu/sub μ/ → nu/sub e/). The detector was located at an effective distance of 20 m from the water target. The beam was composed primarily of muon-neutrinos from pion decay, and the neutrino flux (of mean energy 150 MeV) was computed to be 6.2 x 10^5 nu/cm^2-sec for 20 μA of proton beam on our target. We saw no evidence for oscillations, and were able to set upper limits $\sin^2(2\Theta) \leq 8.8 \times 10^{-3}$ (90% C.L.) (in the limit of large Δm^2) and $\Delta m^2 \sin(2\Theta) \leq 0.59$ eV^2 (in the limit of small Δm^2).

46504 (DOE/ER/03539—46) A search for the C-nonvariant decay $\pi 0 \rightarrow 3\gamma$. McDonough, J. . (Temple Univ., Philadelphia, PA (USA). Dept. of Physics). May 1987. Contract AC02-76ER03539. 139p. (COO—3539-46). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013919.

A new experimental search for the C-violating decay $\pi^0 \rightarrow 3\gamma$ has been undertaken using the Crystal Box detector at the Clinton P. Anderson Meson Physics Facility (LAMPF). The observation of this decay mode would indicate that the electromagnetic interaction of hadrons is not invariant under charge conjugation. No 3γ events in excess of background were observed. The 90% confidence level upper limit is lowered to 3.1 x 10^{-8}.

46505 (DOE/ER/10713—8B) Studies of e^+e^- interactions: Progress report, August 1, 1986-July 31, 1987. Abashian, A.; Gotow, K. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Aug 1987. Contract AS05-80ER10713. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013951.

This paper deals with the activities of the Virginia Tech group for the period of September, 1986 to September, 1987. With the completion of testing of the electromagnetic shower counter in particle beams at the KEK PS in July, attention shifted to preparation and assembly of the detector into its final configuration and to making the detector operational. Later, after shakedown and with the running of the experiment, a second shift occurred in which analysis of physics data became dominant.

46506 (DOE/ER/40130—T2) [Search for neutrino oscillation and measurement of neutrino-nucleus cross sections]: Technical progress report, 15 January 1987 through 15 July 1987. Koetke, D.D. (Valparaiso Univ., IN (USA)). 15 Jul 1987. Contract AC02-84ER40130. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013391.

This report discusses the progress on experiments done at Valparaiso University, New Mexico. The topics covered are: design and development on pion focusing magnets for improved muon neutrino beams, search for the yet unobserved decay, $\mu^+ \rightarrow e^+\gamma$, and analysis of data from the LAMPF accelerators on muon neutrino oscillations. (LSP)

46507 (IFVE-OEIPK—86-54) Systematics of the transverse momentum distributions and azimuthal correlations in K/sup +/p inclusive reactions at 32 GeV/c. Tomaradze, A.G.; Uvarov, V.A.; Shlyapnikov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703101.

Submitted to the journal Sov. J. Nucl. Phys. .

Experimental data on total cross-sections, transverse momentum spectra and azimuthal correlations are presented and compared with the Lund quark model. Modifications in the model required for the description of the experimental data are discussed. 21 refs.; 3 figs.; 3 tabs.

46508 (IFVE-OEIPK—86-159) Study on the correlations between rapidities of two charged π-mesons in p-barp interactions at 32 GeV/c. Bumazhnov, V.A.; Babintsev, V.V.; Bogolyubskij, M.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703102.

Submitted to the journal Sov. J. Nucl. Phys. .

Rapidity distributions of inclusive C/sup ij/(y/sub 1/, y/sub 2/) and semi-inclusive C/sup iJ//sub n/(y/sub 1/, y/sub 2/) correlation functions in p-bar p-interaction at 32 GeV/c are analysed. The data are compared with those from the K/sup -/p experiment at the same energy and predictions of the Lund quark fragmentation model. The correlation functions are shown to be weakly dependent on resonance production, diffractive dissociation and annihilation processes. 21 refs.; 5 figs.

46509 (INIS-mf—10654) Neutron-proton scattering experiments and phase analyses for the n-p system in the energy range from 17 to 50 MeV. Krupp, H. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). 27 Jun 1986. 133p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752467.

In the framework of the study of the nucleon-nucleon interaction neutron-proton scattering experiments were performed at the neutron collimator POLKA of the Karlsruhe cyclotron. Neutrons were produced by the source reaction D(d,n)X in the energy range between 17 and 50 MeV. Measured were the differential cross section, the analyzing power, and the spin correlation coefficient of the elastic n-p scattering. By means of the new data the knowledge of the isospin T=0 scattering phases could be improved. It is for the first time possible to determine the scattering phases for T=1 independently from n-p and p-p data with comparable accuracy. (orig./HSI).

46510 (KFK—4251) Clustertopology of multihadronic events in the e/sup +/e/sup -/-annihilation. Boehrer, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Apr 1987. 100p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-10826.

We measured multihadronic events with the detector CELLO at the e/sup +/e/sup -/ storage ring PETRA. At an energy $\sqrt{s}$=44 GeV we determined the strong coupling constant α/sub s/ with a generalized energy flow S/sup pw/, a jet measure sensitive to the particle distribution of an event. The result is consistent with former measrements at 34 GeV. We selected 3-jet events at 44 GeV. Events having a lowest energy jet with an energy of about 7 GeV were compared to 2-jet events at 14 GeV. The mean transversal momentum of the third jet turns out to be somewhat higher than that of the reference jets at 14 GeV.

46511 (LBL—91-Rev.-3-87) Current experiments in elementary particle physics. Wohl, C.G.; Armstrong, F.E., Oyanagi, Y.; Dodder, D.C.; Ryabov, Yu.G.; Frosch, R.; Olin, A.; Lehar, F.; Moskalev, A.N.; Barkov, B.P. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 166p. NTIS, PC A08. File Number DE87013961.

This report contains summaries of 720 recent and current experiments in elementary particle physics (experiments that finished taking data before 1980 are excluded). Included are experiments at Brookhaven, CERN, CESR, DESY, Fermilab, Moscow Institute of Theoretical and Experimental Physics, Tokyo Institute of Nuclear Studies, KEK, LAMPF, Leningrad Nuclear Physics Institute, Saclay, Serpukhov, SIN, SLAC, and TRIUMF, and also experiments on proton decay. Instructions are given for searching online the computer database (maintained under the SLAC/SPIRES system) that contains the summaries. Properties of the fixed-target beams at most of the laboratories are summarized.

46512 (SLAC-PUB—4336) Search for close-mass lepton pairs (L^-,L^0). Stoker, D.P., Perl, M.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Johns Hopkins Univ., Baltimore, MD (USA)). May 1987. Contract AC03-76SF00515. 4p. (CONF-870390—10). NTIS, PC A02. File Number DE87013585.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

Preliminary results are reported of a search in 207 pb^{-1} of MARK II PEP data at $\sqrt{s}$ = 29 GeV for lepton pairs (L^-,L^0) where the L^0 mass can be close to, but not exceed, the L^- mass. The numbers of e - μ, and 3 or more charged hadrons versus isolated e or μ, events are compared to Monte Carlo predictions for $e^+e^- \rightarrow tau^+tau^-$, $e^+e^- \rightarrow q$ anti q, and two-virtual-photon processes. Possible residual signals for (L^-,L^0) pairs are compared to Monte Carlo simulations and 2σ confidence level limits on the L^- and L^0 masses are presented.

46513 (SLAC-PUB—4350) Detecting beauty baryons and heavy beauty mesons with the J/PSI trigger. Bigi, I.I.; Clavelli, L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Alabama Univ., University (USA). Dept. of Physics and Astronomy). Jun 1987. Contract AC03-76SF00515;FG05-84ER40141. 3p. (CONF-8705163—3; UA-HEP—873). NTIS, PC A02. File Number DE87013587.

From From colliders to supercolliders workshop; Madison, WI, USA (11 May 1987).

The combination of a vertex detector with a J/PSI trigger should enable one to measure the masses and lifetimes of various beauty baryons and heavy beauty mesons at the SSC or Tevatron II.

46514 (SLAC-PUB—4360) Experimental review of light quark spectroscopy from e^+e^- production and $\gamma\gamma$ collisions. Toki, W.H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1987. Contract AC03-76SF00515. 6p. (CONF-8704177—5). NTIS, PC A02. File Number DE87014312.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

This is an experimental review of light quark spectroscopy from e^+e^- production and $\gamma\gamma$ collision results presented at the 2nd International Conference on Hadron Spectroscopy at KEK, Japan. The recent results in $\gamma\gamma$ production have evidence for the J/sup PC/ = 1^{++}, E/f_1(1420) and D/f_1(1285), mesons from the TPC and Mark II collaborations and upper limits for pseudoscalar resonances from the Crystal Ball collaboration. The results in J/psi reactions include D/f_1(1285) meson production in radiative decays and a complete measurement of the hadronic decays into pseudoscalar-vector pairs from the DM2 collaboration and evidence for phi phi production in radiative decays and a study of the iota line shape from the Mark III collaboration. A short review of simple theoretical ideas is presented.

46515 Present activity and future plans at Fermilab. Lederman, L. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 1499-1503 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author summarizes the critical path for getting the machinery on this fall completion of the interaction hall at D-zero and the erection of shielding walls so that the assembly hall can continue to be constructed. This is on schedule. The overpass takes the main ring and loops up 20 feet and around the CEF detector. The main ring, accelerates from 8 GeV to 150 GeV. The basic scheme of the p-bar source is that the main ring accelerates to 120 GeV, then the beam is extracted and delivered to the p-bar target. Antiprotons are produced, focused, and injected into the two concentric storage rings where they are cooled and accumulated for some hours. They are then injected back into the main ring now orbiting in a sense opposite to protons. They are accelerated to 150 GeV and transferred to the Tevatron and accelerated along with protons to high energy. The energy has to go to 900 GeV. Lots of work is to be done on the booster, and the fixed target beam lines and experiments are being completed and made ready for beam. CDF is complete, in the sense that any detector is ever complete, by November of 1987. It is expected on December 1st to begin high energy physics, starting with pp-bar collisions, hopefully at 1.8 GeV, for approximately three months.

46516 The ACP multiprocessor system at Fermilab. Nash, T.; Areti, H.; Atac, R.; Biel, J.; Case, G.; Cook, A.; Fischler, M.; Gaines, I.; Hance, R.; Husby, D. (Advanced Computer Program, Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 1459-1463 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Two versions of the ACP have been developed: one uses Motorola's 68020 32 bit microprocessor, the other runs with AT & T's 32100. Both include the corresponding floating point coprocessor chip. The first system when fully configured, uses 70 each of the two types of processors. A 53 processor system operates for several months with essentially no down time by computer operators in the Fermilab Computer Center, performing at nearly the capacity of 6 CDC Cyber 175 mainframe computers. The VME crates in which the processing "nodes sit are connected via a high speed "Branch Bus" to one or more MicroVAX computers which act as hosts handling system resource management and all I/O in offline applications. An interface from Fastbus to the Branch Bus developed for online use which tests error free at 20 MBytes/sec for 48 hours ACP hardware modules are available commercially. A major package of software, including a simulator that runs on any VAX, has been developed. It allows easy migration of existing programs to this multiprocessor environment. This paper describes the ACP Multiprocessor System and early experience with it at Fermilab and elsewhere.

46517 Search for long range interactions at highly relativistic velocities. Reiner, P.; Melissinos, A.C.; Rogers, J.; Wuensch, W.; Semertzidis, J.; Fowler, W.B. (Dept. of Physics and Astronomy, Univ. of Rochester, Rochester, NY 14627). pp 1487-1489 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors use the Fermilab Tevatron to search for unknown weak long range forces between the accelerator's proton beam at 800 GeV and a stationary detector. Assuming an inverse distance squared force law with dimensionless coupling between the detector and beam masses; the upper limit of the Newtonian gravitational constant is found.

46518 Photon-photon physics with the Mark II at PEP. Cords, D.; Gidal, G.; Boyer, J.; Butler, F.; Abrams, G.S.; Amidei, D.; Baden, A.R.; Barklow, T.; Gold, M.S.; Goldhaber, G. (Lawrence Berkeley Lab. and Dept. of Physics, Univ. of California, Berkeley, CA 94720). pp 1215-1219 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00098;AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Photon-photon interactions are studied with the Mark II detector at PEP. The inclusive production of charged hadrons at large transverse momenta are compared with recent hard scattering calculations. Copious inclusive production of K°'s at large transverse momenta provides evidence for charm production. The radiative width of the f'(1520) is measured via its K°/sub s/K-bar°/sub s/ decay mode.

46519 **Searches for monopoles and quarks.** Matis, H.S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720 U.S.A.). pp 627-631 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00098.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Within the last year, several sensitive searches for monopoles and quarks have been done. Recent experiments at the Tevatron and at the CERN pp-bar collider have detected no evidence for free fractional charge. An experiment in a iron refinery, which searched for GUT monopoles trapped in iron ore with two SQUID detectors, found no monopole candidate. However, an experiment looking for monopoles in cosmic rays has measured an interesting event which could be interpreted as a monopole. Several detectors are being built to achieve significant improvements in sensitivity for detection of quarks and monopoles.

46520 **Non-accelerator experiments.** Goldhaber, M. (Brookhaven National Lab., Upton, NY 11973). pp 248-251 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author discusses about "Non-accelerator Experiments" coherent field of physics. The aims pursued in these experiments overlap often with aims pursued in accelerator experiments. Much physics done in the eighties, especially in the non-accelerator field, can be characterized as the "physics of pushing limits". Some of these limits (masses, mixing angles, abundances, etc.) may be too small to be detected with present day techniques. They may even be zero, a number that experiment can approach, but not reach; it can only be a theoretical prediction. Experimenters, therefore, must beware of "false positives". As rapporteur for non-accelerator experiments, the author could not avoid taking of experiments in progress or planned.

46521 **Branching ratio of $\Xi 0 \rightarrow \Lambda\gamma$, a weak radiative hyperon decay.** James, C.; Heller, K.; Handler, R.; Lundberg, B.; Pondrom, L.; Sheaff, M.; Wilkinson, C.; Border, P.; Dworkin, J.; Overseth, O.E. (School of Physics and Astronomy, Univ. of Minnesota, Minneapolis, MN 55455). pp 877-879 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The branching ratio $\Xi^0 \rightarrow \Lambda\gamma$ / $\Xi^0 \rightarrow \Lambda\pi^0$ has been measured at the Fermilab neutral hyperon facility. 100,000 $\Xi^0 \rightarrow \Lambda\pi^0$ decays were detected by identifying the subsequent $\Lambda \rightarrow$ rhoπ/sup -/ and $\pi^0 \rightarrow \gamma\gamma$ decays in a multiwire proportional chamber magnetic spectrometer and an array of lead glass. A sample of 6.7 x 10/sup 5/ $\Lambda + \gamma$ events were analyzed and a preliminary result indicates that 170 $\Xi^0 \rightarrow \Lambda\gamma$ decays have been identified. Monte carlo studies give the relative acceptances of the two decay types, and in turn the branching ratio.

46522 **Search for rare muon and pion decay modes with the crystal box detector.** Hoffman, C.M.; Bolton, R.D.; Bowman, J.D.; Cooper, M.D.; Frank, J.S.; Hallin, A.L.; Heusi, P.; Hogan, G.E.; Mariam, F.G.; Matis, H.S. (Los Alamos National Lab., Los Alamos, NM 87545). pp 866-869 of Proceedings of the XXIII international conference on high energy physics. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

New experiment upper limits for the branching ratios of the lepton-family-number nonconserving decays μ/sup +/ $\rightarrow$ e/sup +/γ and μ/sup +/ $\rightarrow$ e/sup +/$\gamma\gamma$ are presented. A new determination of γ, the ratio of pion axial-vector to vector form factors, from radiative pion decay is also reported. These results are from data taken with the Crystl Box detector at LAMPF.

46523 **Single photon production in e/sup +/e/sup -/ annihilation.** Whitaker, S. (Physics Dept., Boston Univ., Boston, MA 02215). pp 602-607 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Results are presented from the ASP, MAC, CELLO, and Mark J detectors for the production of single photons in electron positron annihilation. Upper limits on the production of single photons are expressed as upper limits on the number of light neutrino species and lower limits on the masses of supersymmetric particles. The ASP experiment has determined a limit on the selectron mass of 65.7 GeV for the case of degenerate selectron masses and massless photinos, and has determined a limit of 7.5 for the number of light neutrino species. The combined 90% confidence limit from the ASP, MAC, and CELLO experiments for the number of light neutrino species is 4.9.

46524 **A measurement of the spin-parity of the $\omega\pi$/sup 0/ state at 1200 MeV/c/sup 2/ in $\gamma p \rightarrow p\omega\pi$/sup 0/ at 20 GeV.** Brau, J.E.; Franek, B.; Wester, W.C. III. (Univ. of Tennessee, Knoxville, TN 37996-1200). pp 733-735 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The SLAC Hybrid Facility photoproduction experiment has studied the low mass $\omega\pi$/sup 0/ enhancement in the reaction γrho $\rightarrow$ rho$\omega\pi$/sup 0/. The angular distribution of the production plane relative to the polarization vector (P/sub γ/ = 0.52) shows structure consistent with an s-channel helicity non-conserving process. The authors compare our decay angular distributions to the measurements of the Omega Photon Collaboration from which they concluded that this reaction is dominated by non-SCHC production of the J/sup P/ = 1/sup +/ B(1235) meson. Their parametrizations of the angular distributions agree well with the author's data.

46525 **Resonant neutrino oscillations within the solar interior.** Parke, S.J. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 921-924 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Analytic results are derived for the electron neutrino survival probability after passage through a resonant oscillation region. This survival probability together with a sophisticated model of the production distribution of the solar neutrino sources and the solar electron number density are used to study the effects of resonant neutrino oscillation in the solar interior on the current and proposed solar electron neutrino experiments. The results are presented as contour plots for the electron neutrino capture rate, in the mass difference squared versus vacuum mixing angle plane, for the current /sup 37/Cl experiment and the proposed /sup 71/Ga detector.

46526 **Matter oscillations and solar neutrinos: A review of the MSW effect.** Rosen, S.P.; Gelb, J.M. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 909-920 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors review the theory of the Mikheyev-Smirnov-Wolfenstein effect, in which matter oscillations can greatly enhance "in vacuo" neutrino oscillations, and they examine its consequences for the solar neutrino problem. Using a two-flavor model, they dis-

cuss the solutions in the Δm/sup 2/-sin/sup 2/2Θ parameter space for the /sup 37/Ciota experiment, and describe their predictions for the /sup 71/Ga experiment and for the spectrum of electron-neutrinos arriving at earth. The authors also comment on the three-flavor case.

46527 **The U.C. Irvine mobile neutrino-oscillation experiment.** Baumann, N.; Greenwood, Z.D.; Gurr, H.S.; Kropp, W.R.; Mandelkern, M.; Price, L.R.; Reines, F.; Sobel, H.W. (The Savannah River Plant, Aiken, SC). pp 906-908 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Preliminary results are reported from the Irvine Neutrino Oscillation Experiment. This is an electron-antineutrino disappearance experiment at a reactor, and is sensitive to mass squared differences in the range — .02 to — 3. eV/sup 2/.

46528 **Limit on tau neutrino mass.** Bylsma, B. (Argonne National Lab.). pp 897-899 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Using the complete data sample of 300 pb/sup -1/ collected by the HRS spectrometer in e/sup +/e/sup -/ collisions at 29 GeV, a mass limit for the tau neutrino is set. The end point of the hadronic mass spectrum is determined in the decays tau → 5π/sup +-/ν/sub tau/ and 5π/sup +-/π/sup 0/ν/sub tau/. At 95% confidence level, an upper limit of Mν/sub tau/ < 76 MeV/c/sup 2/, is found.

46529 **Sigma minus form factors and magnetic moment.** Winston, R. (Enrico Fermi Institute and Dept. of Physics, The Univ. of Chicago, 5640 South Ellis Avenue, Chicago, IL 60637). pp 883-886 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author reports results from a Fermilab polarized Sigma minus decay experiment. From a sample of 50,000 beta decays and 10/sup 6/ two body decays with polarization parallel to the magnetic field he has extracted the semi-leptonic form factors. From another sample of 21,000 beta decays and 650,000 two body decays where the polarization processed in the magnetic field he has measured the magnetic moment.

46530 **Study of π/sup +/π/sup -/ transitions from the Υ(3S).** Bowcock, T.; Giles, R.T.; Hassard, J.; Kinoshita, K.; Pipkin, F.M.; Wilson, R.; Wolinski, J.; Xiao, D.; Gentile, T.; Haas, P. (Harvard Univ., Cambridge, MA 02138). pp 641-645 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors have investigated the transitions Υ(3S)→π/sup +/π/sup -/Υ(1S), Υ(3S)→π/sup +/ π/sup -/Υ(2S), and the cascade process Υ(3S)→Υ(2S)+X; Υ(2S)→π/sup +/π/sup -/Υ(1S), both in the exclusive decay mode where the daughter Υ state decays into two leptons, and in the inclusive decay mode where the daughter Υ state decays hadronically. Results are presented on branching fractions and the properties of the π/sup +/π/sup -/ system. Possible evidence for the transition Υ(3S)→π/sup +/π/sup -/Υ(1/sup 1/P/sub 1/) is presented.

46531 **The D width and the study of F and F.** Sugano, K. (Argonne National Lab., Argonne, IL 60439). pp 646-651 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Recent results on the D, F, and F production in e/sup +/e/sup -/ from HRS and MARK III are summarized. An improved upper limit on the decay width of D is reported. A brief review of the characteristics of F and the updated data of the F production in e/sup +/e/sup -/ are given. A new measurement on F is made using the associated production method in the reaction e/sup +/e/sup -/ → FF.

46532 **Short-lived axion searches with long beam dumps.** Luk, K.B. (Fermilab, Batavia, IL 60510). pp 632-634 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Searches for axions with lifetime less than 10/sup -11/ sec and decaying into e/sup +/e/sup -/ pairs were performed in an 800 GeV proton, and a 2.5 GeV electron beam dump experiments. No axion is found and the existence of a short-lived penetrating neutral particle with mass less than 2.4 MeV and only coupled to electron is ruled out.

46533 **An electron beam dump search for light, short-lived particles.** Riordan, E.M.; De Barbaro, P.; Bodek, A.; Dasu, S.; Krasny, M.W.; Lang, K.; Varelas, N.; Wang, X.R.; Arnold, R.; Benton, D. (Univ. of Rochester, Rochester, NY 14627). pp 635-637 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors report preliminary results of an electron beam dump search for neutral, penetrating particles X/sup 0/ with masses in the range 1 < m/sub X/ < 12 MeV and lifetimes tauX between 10/sup -14/ and 10/sup -11/ sec. No evidence was found for such an object in runs with a total of 10/sup 15/ e/sup -/ on dump. They specifically rule out the existence of any possible 1.8 MeV pseudoscalar with tauX > 2 X 10/sup -14/ sec and an absorption cross-section in matter less than 150A/sup 0.7/ mb pr nucleus. Inasmuch as measurements of the electron's anomalous magnetic moment constrain tauX > 7 X 10/sup -14/ sec for a neutral 1.8 MeV pseudoscalar boson, this experiment excludes the recent GSI phenomenon as an elementary pseudoscalar.

46534 **Heavy leptons in 1986.** Perl, M.L. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 596-601 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author updates recent reviews on the search for new leptons beyond the electron, muon, and tau generations. The author also discusses an unexplored region in the mass ranges of leptons; small visible energy events in electron-positron annihilation and close-mass pairs.

46535 **Recent CLEO results on B meson decays (mostly) to leptons and dileptons.** Poling, R. (Univ. of Rochester, Rochester, NY 14627). pp 768-772 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Recent results on B production and decay from the CLEO experiment are reviewed. The validity of the assumption that Y (4S) decays exclusively to BB-bar is examined, and new limits are presented for Γ (b→μ)/Γ (b→c), for B/sup 0/B/sup 0/ mixing, and for the ratio of the charged and neutral B meson semileptonic branching fractions.

46536 **New PEP tau and B-lifetime results.** Ritson, D.M. (Dept. of Physics and Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 809-812 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

New results on tau and B-lifetimes obtained at the PEP colliding beam ring are presented.

46537 **Recent mark III results on radiative and hadronic j/psi decays.** Kopke, L. (Santa Cruz Institute for Particle Physics Univ. of California Santa Cruz, CA 95064). pp 692-699 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Recent results from the Mark III Collaboration on radiative and hadronic J/psi decays are presented, based on a sample of 5.8 X 10/sup 6/ produced J/psi events. A spin analysis of the ξ(2230) indicates non-zero spin. The radiative channels J/psi → γphiphi and J/psi → γωphi are discussed. A comparison of J/psi → {γ,ω,phi}X decays is made. The examinations of the final states X = {K K-bar, ππ, K K-barπ, etaππ, 4π} reveals possible evidence for the θ(1720) and no indication for the iota(1450) in the hadronic decays. A partial study of the O/sup ++/ meson multiplet in J/psi two-body decays shows that the δ(980) is probably not a qq-bar state.

46538 **A search for the ξ(2.2) in p-barp formation.** Sculli, J.; Christenson, J.H.; Kreiter, G.A.; Nemethy, P.; Yamin, P. (Dept. of Physics, New York Univ., 4 Washington Place, NY, NY 10003). pp 706-708 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors report the results of a search at the Brookhaven National Laboratory AGS for the ξ(2.2) with a mass resolution of 3MeV/c/sup 2/. Thirty-seven thousand events of the form p-barp → K/sup +/K/sup -/ and two hundred thousand events of the form p-barp → π/sup +/π/sup -/ were studied in the incident momentum interval from 1.25 GeV/c to 1.56 GeV/c, corresponding to a mass interval of 110 MeV/c/sup 2/ about the reported ξ mass. They find no evidence for ξ formation.

46539 **A study of strange and strangeonium states produced in LASS.** Aston, D.; Awaji, N.; Bienz, T.; Bird, F.; D'Amore, J.; Dunwoodie, W.; Endorf, R.; Fujii, K.; Hayashii, H.; Iwata, S. (Stanford Linear Accelerator Center, Stanford Univ., P.O. Box 4349, Stanford, CA 94305). pp 718-724 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Results are presented from the analysis of several final states from a high-sensitivity (4 ev/nb) study of inelastic K/sup -/rho interactions at 11 GeV/c carried out in the LASS Spectrometer at SLAC. New information is reported on leading and underlying K/sup */ states, and the strangeonium states produced by hypercharge exchange are compared and contrasted with those observed in radiative decays of J/psi.

46540 **New results on tau polarization measurement and electroweak interference in e/sup +/e/sup -/ annihilation into hadrons.** Maruyama, T. (Dept. of Physics, Univ. of Wisconsin, Madison, WI 53706). pp 975-978 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

New results are presented on test of the electroweak theory. Topics discussed are; Tau polarization measurement by MAC, and Forward-backward asymmetry measurements in hadron production by CELLO, HRS, and MAC.

46541 **The results of two scattering processes: ππ → phiphi and ππ → KK-bar.** Longacre, R.S.; Chan, C.S.; Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Kramer, M.A.; Lindenbaum, S.J.; Love, W.A.; Morris, T.W.; Platner, E.D. (Brookhaven National Lab., Upton, NY 11973). pp 729-732 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC02-76CH00016;AC02-83ER40107.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors present an analysis of 6658 events of the reaction π/sup -/rho → phiphin at 22 GeV/c. This data is well represented by three resonances, all with quantum numbers I/sup G/J/sup PC/ = 0/sup +/2/sup ++/. In a second analysis, which consists of 40494 new events of the reaction π/sup -/rho → K°/sub s/K°/sub s/n at 22 GeV/c, the authors obtain the S/sub 0/, D/sub 0/ and G/sub 0/ Argand amplitudes for ππ → KK-bar. The θ (1690) is shown to decay into ππ by less than 4% and only is required in J/psi radiative decay experiments.

46542 **Some aspects of quark fragmentation: Comparison of heavy (c) and light quarks (u,d,s).** Derrick, M. (Argonne National Lab., Argonne, IL 60439). pp 748-763 of Proceedings of the XV international symposium on multiparticle dynamics. Gustafson, G.; Peterson, C. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406183—).

From 15. international symposium on multiparticle dynamics; Lund, Sweden (11 Jun 1984).

The data that is presented comes from the first two years of operation of the High Resolution Spectrometer (HRS) at PEP, and corresponds to an integrated luminosity of 106 +- 5 pb/sup -1/ (20 pb/sup -1/ from the first year and 86 pb/sup -1/ from the second year's running). Since the quark-meson transitions have a particularly simple form at the values of the momentum fraction Z = /sup 2p/meson/√s, this aspect of the data is emphasized, and shows how a sample of e/sup +/e/sup -/ → (uu-bar, dd-bar, ss-bar) events are selected. The characteristics of these events are compared to e/sup +/e/sup -/ → cc-bar selected by a D* tag.

46543 **Glueball candidates in hadroproduction.** Chung, S.U. (Brookhaven National Lab., Upton, NY 11973). pp 186-200 of Proceedings of the XV international symposium on multiparticle dynamics. Gustafson, G.; Peterson, C. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406183—). Contract AC02-76CH00016.

From 15. international symposium on multiparticle dynamics; Lund, Sweden (11 Jun 1984).

Glueball candidates in hadron-hadron collision processes are reviewed. So far, candidates have been reported in J/sup PC/ = 0/sup ++/, 2/sup ++/ and 0/sup -+/ but none in the exotic J/sup PC/ such as 1/sup -+/.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 46388, 46389, 46491, 46512, 46522, 46534, 46540, 46543, 46594, 46596, 46609, 46615, 46618, 46621, 46626, 46630, 46639, 46702

46544 (BNL—40075) An event generator for ultrarelativistic proton proton collisions: A multistring model. Werner, K. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-870543—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013312.

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

A multistring model for low p/sub t/ proton proton collisions is presented. The process is divided into two independent steps: formation of color strings and subsequent fragmentation of strings. Taken into account is diffractive and nondiffractive contributions, each contribution consisting with a certain probability w/ sub i/ of 2i strings. The i > 1 contributions correspond to "multi-Pomeron exchange."

46545 (BNL—40203) Rare W decays at the SSC [superconducting super collider]?. Paige, F.E. (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 9p. (CONF-870739—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014427.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

The feasibility of studying rare W decays at the SSC is considered. It seems unlikely that hadronic decays can be observed with greater sensitivity than that obtainable at LEP 200. Interesting purely leptonic decays occur in some models and might be observable. The sensitivity will be limited by backgrounds, so excellent lepton identification, jet recognition, and missing pT resolution are needed.

46546 (BNL—52079, pp 1-12) **Neutrino physics - a theoretical perspective.** Marciano, W.J. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Experimental measurements of sin² theta/sub W/ are surveyed. They are shown to test electroweak unification at the quantum loop level and constrain new physics beyond the standard model. Neutrino oscillations are also examined in the framework of 3 generation mixing. Searches for nu/sub μ/ → nu/sub tau/ oscillation at accelerator facilities are advocated.

46547 (BNL—52079, pp 89-110) **Effects of the third generation on neutrino oscillations in vacuum and matter.** Kim, C.W. (Johns Hopkins Univ., Baltimore, MD). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Analysis of neutrino oscillation data is presented with emphasis on the role of the third generation neutrino. Differences between the two and three generation cases are highlighted. The implications of recent results on the solar neutrino problem are also discussed.

46548 (BNL—52079, pp 111-119) **Resonant solar neutrino oscillation versus laboratory neutrino oscillation experiments.** Lim, C. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The interplay between resonant solar neutrino oscillations and neutrino oscillations in laboratory experiments is investigated in a 3 generation model. Due to the assumed hierarchy of neutrino masses, together with their choice of a convenient parameterization of the 3 generation mixing matrix, they can derive a simple analytic formula which reduces the solar neutrino problem to an effective 2 generation problem. The reduction makes it apparent that the allowed range of mixing and mass parameters crucially depend on whether the survival probability of solar neutrinos S satisfies S ≧ 1/3 or not. The formulae for probabilities of laboratory neutrino oscillations are also greatly simplified. They argue that a combination of the observed solar neutrino depletion and data obtained from reactor experiments seems to rule out some range of neutrino masses. If a sizable nu/sub μ/ → nu/sub e/ oscillation is observed at accelerators, as suggested at this Workshop, it severely restricts the range of 2 mixing angles.

46549 (BNL—52079, pp 121-135) **Matter oscillations: neutrino transformation and regeneration in the earth.** Baltz, A.J.; Weneser, J. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Transformation and regeneration phenomena are calculated to result from transmission through the Earth of neutrinos with E(MeV)/Δm² (eV)² in the vicinity of 10^6 to 10^7. As a result, large time-of-night and seasonal variations are predicted for various solar neutrino experiments in this parameter range. Analogous effects are predicted for terrestrial cosmic ray and accelerator experiments.

46550 (BNL—52079, pp 195-203) **Effect of extra neutral gauge bosons on neutrino-electron scattering.** Godfrey, S.; Marciano, W.J. 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The effects of additional neutral gauge bosons on neutrino-electron scattering cross sections are examined. Existing data is shown to provide bounds in the 100-250 GeV range for a class of E_6 inspired models. Estimates of the precision reachable in ongoing measurements indicates that those bounds should approach 400 GeV and a proposed new experiment at Los Alamos may probe mass scales of order 800 GeV.

46551 (BNL—52079, pp 205-220) **Weak neutral current.** Langacker, P. (Univ. of Pennsylvania, Philadelphia). 1987. NTIS, PC A11/MF A01. File Number DE87012506. (CONF-870283—).

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The results of a detailed analysis of existing data on the weak neutral current and the W and Z masses are presented. The weak angle is found to be sin² theta/sub W/ identical with 1 - M/sub W/²/M/sub Z/² = 0.230 +/- 0.0048, where the error includes full statistical, systematic, and theoretical uncertainties. Allowing rho identical with M/sub W/²/(M/sub Z/² cos² theta W) to vary one obtains rho = 0.998 +/- 0.0086. Implications for tests of the standard model at the level of radiative corrections, non-standard Higgs representations, m/sub t/ and heavy fourth family fermions, grand unification, and possible additional Z bosons are discussed.

46552 (BONN-HE—87-07) On the gauge (in)dependence of the dynamical quark mass. Reinders, L.J.; Stam, K. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Apr 1987. 9p. NTIS, PC E07; Available from NTIS as TIB/B87-10864.

We compute the contribution of the mixed quark-gluon condensate to the quark self-energy to all orders in the dynamical quark mass. We investigate the consistency of different expansion schemes. It is found that nonabelian interactions form an obstruction to defining a true dynamical gauge independent mass shell.

46553 (CERN—87-02) 1986 CERN School of Physics. Proceedings. (European Organization for Nuclear Research, Geneva (Switzerland)). 30 Mar 1987. 310p. (CONF-8606329—). NTIS (US Sales Only), PC A14/MF A01. File Number DE87703049.

From CERN school of physics; Sandhamn, Sweden (8 Jun 1986).

The CERN School of Physics is intended to give young experimental physicists an introduction to the theoretical aspects of recent advances in elementary particle physics. These proceedings contain reports of lecture series on the following topics: introduction to symmetries and gauge theories, quark dynamics, experimen-

tal tests of gauge theories, proton antiproton collider results and detectors, physics at LEP, superphysics, and quantum black holes.

46554 **(DOE/ER/40200—107) Leptoquark signals at e^+e^- colliders.** Hewett, J.L.; Rizzo, T.G. (Texas Univ., Austin (USA). Center for Particle Theory). Jun 1987. Contract FG05-85ER40200. 22p. (IS-J—2474). NTIS, PC A02/MF A01. File Number DE87014582.

We examine the production of scalar leptoquark (S) pairs in e^+e^- annihilation along with indirect limits of leptoquark properties from existing e^+e^- data and that which can be obtained in the near future from the SLC and LEP.

46555 **(IC—86/247) New potential model for heavy quarkonium.** Song Xiaotong; Lin Hefen. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703053.

A new potential model for heavy QQ-bar system is suggested. The potential is a simple superposition of square root potential and inverse square root potential. They are inspired by QCD and experimental facts. Using this potential, the level and decay rates for heavy quarkonium are calculated. Most results agree with the experiment. 22 refs.

46556 **(IC—86/268) Test of the transverse magneticity of the $\xi(2.23)$.** Ward, B.F.L. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703054.

We propose the Jacob-Wick helicity amplitude ratios x-bar=A/sub 1//A/sub 0/ and y-bar=A/sub 2//A/sub 0/ for PSI/J -> $\gamma\xi$, ξ -> K/sup +/K/sup -/, as tests of the transverse magneticity of the two gluon constituents of the $\xi(2.23)$ under the assumption that the latter state is in fact a spin 2 bound state of two constituents gluons. Here A/sub j/ is the respective amplitude for ξ helicity j, j=0,1,2. We therefore encourage experimentalists to measure these ratios. 12 refs, 3 figs.

46557 **(IC—86/277) O(5) x U(1) electro weak gauge theory and the exact relation between the Cabibbo and the Weinberg angles.** Samiullah, M. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703056.

In the present study we have employed the group O(5)xU(1). The group is economical in the number of gauge bosons, which we associate with each of its generators, and anomaly free. The left-handed quarks Q/sub L//sup T/=(u,d,s,c)/sub L/ are assigned to the four dimensional spinorial representations of O(5). The right-handed particles u/sub R/, d/sub R/, s/sub R/, c/sub R/ are taken to be the singlets of the group. We have briefly sketched the relevant mathematics used in our work. The table of relevant quantum numbers is given. The charge operator is defined. Conventionally the mixing of the quark fields is achieved by an appropriate choice of the Higgs couplings which appear in quark mass matrix. However, in the present approach the Cabibbo angle is introduced through the mixing of the additional charged gauge bosons as compared to the GWS model. The theory has three sets of gauge bosons (i) analogues of the GWS model (ii) additional charged gauge bosons already mentioned and (iii) a set of three neutral gauge bosons. We find the appropriate mixing by an angle 2θ/sub c/ warranted by the group theory and that the additional neutral currents of the theory remain form invariant. Also it produces the exact combinations of the GWS analogue gauge bosons to yield A/sub μ/ and Z/sub μ//sup O/, establishing the exact relation θ/sub w/=2θ/sub c/. The electromagnetic coupling constant is given as usual by 'e'. This result is established here theoretically for the first time to the knowledge of the author and is borne out by the experimental data. However, in view of the exact relation it leaves room for the reconsideration of the data by the experimentalists. 7 refs.

46558 **(IC—86/284) Salam-Weinberg symmetry breaking with superheavy Higgs particles.** Misra, S.P. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703057.

We discuss here the possibility of the breaking of the Salam-Weinberg symmetry by Higgs particles which are superheavy. The symmetry-breaking is associated with a nonzero vacuum expectation value of fermion condensates. This mechanism, if operative in nature, will imply the absence of Higgs particles at the weak scale. 20 refs.

46559 **(IC—86/312) Signal for quark gluon plasma in fragmentation region.** Singh, C.P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703064.

After analyzing the recent proposals for observing the signals of quark gluon plasma in the ultra relativistic nucleus-nucleus collisions we suggest that the signals should be better searched for in the fragmentation rapidity region because the complications due to hadronic background can safely be avoided. 21 refs.

46560 **(IC—86/386) Experimental tests of unification models.** Pal, B.K. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703092.

Several tests of unification models are described. SU(5), SO(10) and SU(16) are the models at the grand unification theory level and SU(4)/sub C/xSU(2)/sub L/xSU(2)/sub R/ is at the partial unification theory level. The construction of these groups are briefly discussed. The tests selected for discussion are the existence of intermediate mass-scales spanning the gap between 10/sup 2/-10/sup 15/GeV, observable V+A interactions mediated by W/sub R/'s finiteness of the neutrino mass in the electron volt region, alternative proton-decay modes viz. p -> e/sup +/π/sup 0/, $\nu\pi$/sup +/; p -> e/sup -/π/sup +/π/sup +/; p -> e/sup -/$\nu\nu\pi$/sup +/π/sup +/ etc., neutron oscillations (n -> n-bar) and neutrino oscillations. 14 refs.

46561 **(INIS-mf—10655) Calculation of the pion-nucleon double spectral functions and applications.** Grether, D. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). 16 May 1986. 98p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752466.

In the present thesis the latest results from pion-pion and pion-nucleon phase analyses are applied in order to calculate the pion-nucleon double spectral functions which belong to the elastic unitarity in the t-channel. The equivalence of the partial wave projection of these spectral functions in the s-channel with the elastic t-channel unitarity is extensively discussed. After we summarize the aspects of the pion-nucleon system seeming in this connection interesting we discuss the Mandelstam method for the calculation of the spectral functions by means of the elastic t-channel unitarity as well as the applied input and present the results. Thereafter we use these results in order to calculate by means of a fixed t-channel dispersion relation the real parts of the t-channel cuts. Partial wave projections into the t-channel are proved as equivalent to the elastic t-channel unitarity. We study the compatibility of the asymptotic behaviour of the spectral functions relative to the energy with current Regge pole models. Finally we use our results in order to calculate the pion-nucleon partial waves by means of their Froissart-Gribov representations which follow from their analyticity at fixed energy. (orig./HSI).

46562 **(JINR—R-1-86-67) Calculation of the number of background e/sup +/e/sup -/ -pairs in the experiments on K/sub L/-K/sub S/ regeneration on deuterium.** Sil'vestrov, L.V.; Takhtamyshev, G.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703113.

The calculations and simulations of e/sup +/e/sup -/-pairs were made from the known background processes in connection with the analysis of the production of these pairs in the experiments performed on BIS installation on K/sub L/ - K/sub S/ regeneration on deuterium. As a result, it has been found that the contribution of background pairs does not exceed 15% from the number of the observed excess e/sup +/e/sup -/-pairs. 11 refs.; 5 tabs.

46563 (JINR—R-2-86-142) Energy spectrum of the ($\pi\pi$), (πk), (kk)dimesic atoms. Electromagnetic interaction. Karimkhodzhaev, A.; Faustov, R.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703115.

The properties of dimesic atoms produced by ($\pi\pi$), (πk), (kk)-mesons are discussed. The experimental measurement of the lifetime and of Lamb shift of energy levels of these atoms gives a unique possibility of direct definition of low-energy parameters. In the framework of the Logunov - Tavkhelidze quasi-potential approach the energy levels of the ($\pi\pi$), (kπ), (kk) dimesic atoms are calculated in the one-photon approximation taking into account the hadronic vacuum polarization. The expression for Lamb shift of the dimesic atom is obtained. 17 refs.; 1 fig.

46564 (LBL—23633) Composite weak bosons at supercolliders. Suzuki, Mahiko. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 6p. (CONF-8705163—5; UCB-PTH—87/26). NTIS, PC A02/MFA01; 1; GPO Dep. File Number DE87014119.

From From colliders to supercolliders workshop; Madison, WI, USA (11 May 1987).

Following a brief survey of nongauge interactions of composite W and Z from a theoretical viewpoint, we point out some of conspicuous signatures of compositeness at supercolliders, in particular Wγ and Zγ production through q anti q by interactions of dimension six. In these processes, a suppression factor $1/\Lambda^2$ due to compositeness scale Λ is largely compensated by longitudinal polarizations of W and Z, allowing us to probe up to high values of Λ. 10 refs., 3 figs.

46565 (SLAC-PUB—4369) Search for charged Higgs bosons at SSC [Superconducting Super Collider]. Bengtsson, H.U.; Yamamoto, H.; Komamiya, S. (California Univ., Los Angeles (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1987. Contract AC03-76SF00515. 8p. (CONF-8705163—6). NTIS, PC A02. File Number DE87014315.

From From colliders to supercolliders workshop; Madison, WI, USA (11 May 1987).

We examine the possibility of finding charged Higgs bosons (H^{+-}) at the SSC. The charged Higgs boson is produced with a top quark via a gluon + bottom quark interaction ($g + b \rightarrow H + t$). For the two Higgs doublet models, H^{+-} decays predominantly into t + b. Since the background from QCD processes will be very severe for this decay mode, we studied the $H^{+-} \rightarrow$ tau + nu decay mode. Even for this mode, background from the processes $pp \rightarrow W + t +$ spectators $\rightarrow l +$ nu/sub l/ + t + spectators will be very high. In the two Higgs doublet models, it is very difficult to extract the charged Higgs signal for reasonable values of the ratio of the two vacuum expectation values ($\tan\beta = nu_1/nu_2$).

46566 (UWThPh—1987-07) Electromagnetic mass-differences of mesons. Flamm, D.; Schoeberl, F.; Uematsu, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703130.

We calculate the electromagnetic mass differences of light and heavy vector- and pseudoscalar mesons in the framework of a nonrelativistic potential model. The effect of the isospin violating mass differences appears not only from the quark mass difference m/sub d/ - m/sub u/ but also indirectly via isospin violation induced by this mass difference in the strong interaction which can be much larger than the electromagnetic effect.

46567 (UWThPh—1987-13) Study of wino pair production in e/sup +/e/sup -/ annihilation. Fukai, Tomoki; Kizukuri, Yoshiki; Oshimo, Noriyuki; Otake, Yoshie; Sugiyama, Naoshi. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87703135.

We discuss wino pair production in e/sup +/e/sup -/ annihilation and subsequent leptonic wino decay for various types of supersymmetric or supergravity models. Phenomenological predictions on this process depend considerably on a specific model. We analyze the energy distribution, forward-backward asymmetry and angular distribution of a charged lepton in the final state. (Author shortened by G.Q.).

46568 Poisson-type multiplicity distribution and the Giovannini-Van Hove model. Hoang, T.F.; Cork, B. (Lawrence Berkeley Lab., CA, USA). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **36**: No. 2, 323-328(Sep 1987). Contract AC03-76SF00098.

Properties of a Poisson-type distribution satisfying the same recurrence relation as the negative binomial distribution are investigated using the charged multiplicity data of anti pp, pp, π/sup +/ p, K/sup +/p and e/sup +/e/sup -/ interactions. Its two parameters are found to deviate significantly from the predictions of the Giovannini-Van Hove model. Remarks are made on the property of quark content of the multiplicity due to fragmentation of colliding particles such as p, π/K and e under investigation.

46569 E_6 theories and Higgs boson pair production in e^+e^- annihilation. Rizzo, T.G. (Ames Lab., IA; Iowa State Univ. of Science and Technology, Ames). *Physics Letters [Section] B;* **191**: No. 1/2, 187-190(4 Jun 1987). Contract W-7405-ENG-82.

The production of pairs of Higgs bosons in e^+e^- annihilation in the standard model can only proceed at the one-loop level in the limit that the electron mass is ignored. In E_6 models we show that the existence of exotic leptons and off-diagonal Higgs boson couplings can lead to an appreciable rate for the $e^+e^- \rightarrow 2H^0$ process at the tree level if the mixing between ordinary and exotic leptons is not too small.

46570 QCD glueballs in the presence of dynamcial fermions in a small periodic box. Gavai, R.V.; Gocksch, A.; Heller, U.M. (Brookhaven National Lab., Upton, NY, USA. Physics Dept.; California Univ., San Diego, La Jolla, USA. Dept. of Physics; California Univ., Santa Barbara, USA. Inst. for Theoretical Physics). *Physics Letters [Section] B;* **190**: No. 1/2, 182-186(21 May 1987). Contract AC02-76CH00016;AS03-81ER40029.

We present first results for the masses of the O/sup ++/ and 2/sup ++/ glueballs obtained from a simulation of lattice QCD on a 4/sup 3/.24 lattice with the effects of dynamical fermions included using the pseudo-fermion method. The masses are determined from the exponential falloff of adjoint line correlation functions. We find that M /sub 2++/ < M/sub 0++/, extending an earlier result by Berg, Billoire and Vohwinkel for the pure gauge case to the full theory.

46571 QCD predictions for the photon structure function. Antoniadis, I.; Marleau, L. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 1236-1239 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

This paper presents from a pedagogical point of view, the treatment of the unphysical singularities appearing in the point-like contribution of the photon structure function, F/sup γ//sub 2/ (x,Q/sup 2/). The treatment, based on the parametrization of a singular term, is compared with various other approaches. The authors estimate the magnitude of higher order corrections.

46572 The fifth force. Fischbach, E.; Aronson, S.H.; Sudarsky, D.; Szafer, A.; Talmadge, C. (Physics Dept., Purdue Univ., West Lafayette, IN 47907). pp 1021-1031 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors present a phenomenological description of the "fifth force" which focuses on the implications of the existing data

from satellite and geophysical measurements of gravity, the Eotvos experiment, decays into hyperphotons, and the energy-dependence of the K/sup 0/ - K-bar/sup 0/ parameters.

46573 **KMC unitarity and new physics.** Marciano, W.J. (Brookhaven National Lab., Upton, NY 11973). pp 815-818 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC02-76CH00016.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Experimental constraints on the Kobayashi-Maskawa-Cabibbo (KMC) matrix are surveyed and shown to provide a test of the standard model at the level of its O(α) radiative corrections. The three generation prediction BR(K/sup +/ → π/sup +/ νν-bar) ≅ (0.35 — 3) x 10/sup -10/ is reviewed and the potential for enhancement up to ≈ 3 x 10/sup -9/ due to the fourth generation mixing is described. Constraints on additional neutral gauge boson masses are also discussed.

46574 **Substructure: A brief summary.** Harari, H. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 460-462 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The present status of substructure theories for Higgs particles, quarks, leptons and gauge bosons is briefly summarized.

46575 **First observation of the decay π/sup +/→e/sup +/e/sup -/e/sup +/ν and A determination of the formfactors F/sub V/, F/sub A/ and R.** Grab, C. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 870-873 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The radiative pion decay π/sup +/ → e/sup +/e/sup -/e/sup +/ν is observed for the first time with a branching ratio of (3.4+-0.5) x 10/sup -9/. From the kinematical distribution of 79 events information on the form factors was extracted. The vector form factor F/sub V/ was found to have the same sign as the pion decay constant f/sub π/. For the axial -vector form factors the following values have been measured: γ=F/sub A//F/sub V/ = 0.7+-0.5 and ξ=R/F/sub V/ = 2.3+-0.6. This value of γ agrees well with the small positive value of (0.53+-0.06) and excludes the large negative value obtained in π/sup +/ → e/sup +/νγ experiments.

46576 **Status of the UCLA project for lattice calculation of weak matrix elements.** Bernard, C.; Draper, T.; Hockney, G.; Soni, A. (Dept. of Physics, Univ. of California, Los Angeles, CA 90024). pp 825-830 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors give a very brief review of the status of the UCLA project for calculation of weak matrix elements on the lattice. In the past several months they have increased their data sample by over an order of magnitude over our pilot project. Numerous practical difficulties still remain that do not yet allow them to quote a value for the KK-bar mixing matrix element for left-left currents.

46577 **Weak interaction matrix elements with staggered fermions.** Sharpe, S.R. (Physics Dept., FM-15, Univ. of Washington, Seattle, WA 98195). pp 559-562 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

An overview of the results of the Los Alamos Advanced Computing Group is given. The theory behind the measurement of Weak Interaction Matrix Elements using staggered fermions is presented, and contrasted with that for Wilson fermions. This is followed by a preliminary discussion of numerical results on a 12/sup 3/ x 30 lattice.

46578 **sin/sup 2/ θ/sub w/ and radiative corrections.** Marciano, W.J. (Brookhaven National Lab., Upton, NY 11973). pp 999-1002 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC02-76CH00016.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Precision measurements of sin/sup 2/θ/sub w/ and the effects of radiative corrections are surveyed. A world average sin/sup 2/θ/sub w/ = 0.229 +- 0.004 is obtained. Comparison of deep-inelastic ν/sub μ/N scattering and m/sub w/ or m/sub z/ is shown to test the standard model at the quantum loop level and constrain new physics. Implications for grand unified theories are briefly discussed.

46579 **Implications of the observed K-M angles on future physics.** Shin, M. (Physics Dept., Brown Univ., Providence, RI 02912). pp 763-767 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author discusses the implications of the observed values of the K-M angles on the structure of particle physics beyond the standard model. A hypothesis on the structure of quark mass matrices is proposed along with S.S.B. as the origin of weak-CP violation. The entire K-M angles are well understood in terms of the quark mass ratios alone. Possible symmetries in the family space are discussed. The implications on future experiments are: Γ(b→μeν/sup -/)/Γ(b→ceν/sup -/) = (8.8/sub -3.8//sup +5.8/)x10/sup -3/, and m/sub t/ =42.6/sub -9.5//sup +19.4/ GeV, 48.8/sub -11.5//sup +24.1/ GeV, 56.2/sub -14.3//sup +31.3/ GeV, for vertical barV/sub cb/vertical bar =0.04, 0.05, and 0.06 respectively. ν/sub e/-ν/sub μ/, ν/sub μ/-ν/sub tau/ oscillations may be observable in a foreseeable future.

46580 **The stochastic cell model for hadronic multiparticle distributions.** Carruthers, P.; Shih, C.C. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 174-185 of Proceedings of the XV international symposium on multiparticle dynamics. Gustafson, G.; Peterson, C. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406183—).

From 15. international symposium on multiparticle dynamics; Lund, Sweden (11 Jun 1984).

Hadronic multiplicity distributions, KNO scaling and deviations are examined in this paper in a fairly general framework with emphasis on the negative binomial distribution.

46581 **Quark fragmentation in e/sup +/e/sup -/ annihilation.** Barbaro-Galtieri, A. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 678-713 of Proceedings of the XV international symposium on multiparticle dynamics. Gustafson, G.; Peterson, C. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406183—).

From 15. international symposium on multiparticle dynamics; Lund, Sweden (11 Jun 1984).

Detailed studies of the composition of jets and production properties of particles in jets are essential to understand the dynamics of jet evolution from the qq-bar pair to the final hadrons. The final hadrons, therefore, the interesting region of confinement and perturbative QCD have to be disentangled from non-perturbative effects like resonance or cluster decays. This section reviews the data available on properties of jets: particle type composition and spectra, rapidity and rho/sub perpendicular/ distributions.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 46504, 46616, 46623, 46625, 46627, 46628, 46629, 46631, 46632, 46633, 46634, 46635, 46636, 46637, 46638, 46639, 46833

46582 (IC—86/315) Our universe as an attractor in a superstring model. Maeda, Keiichi. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703066.

One preferential scenario of the evolution of the universe is discussed in a superstring model. The universe can reach the present state as an attractor in the dynamical system. The kinetic terms of the "axions" play an important role so that our present universe is realized almost uniquely. 26 refs, 5 figs.

46583 (IC—86/318) Euclidean supersymmetrization of instantons and self-dual monopoles. Lukierski, J.; Zakrzewski, W.J. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703068.

We show that N=1 D=4 Euclidean supersymmetry leads to the complexification of gauge potentials, and that to have a supersymmetric Euclidean D=4 theory which allows for the selfduality of real gauge potentials, the supersymmetry has to be extended to even N, i.e. at least N=2. We also discuss the supersymmetrization of Manton's procedure of using the dimensional reduction D=4 -> D=3 to derive self-dual monopoles from instantons. 15 refs.

46584 (IC—86/338) Symmetries and constants of motion for new KDV hierarchies. Li Yishen; Cheng Yi. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703074.

In this paper, two sets of symmetries with their infinite dimensional Lie algebra, one set of constants of motion in involution and their expressions in terms of scattering data are given. 6 refs.

46585 (IC—86/353) Response to some remarks by WRFS concerning renormalization group approach to a Bose fluid. Singh, K.K. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703078.

It is pointed out that the renormalization group approach for a Bose fluid developed by the author does not suffer from the infirmities referred to by WRFS (Weichman, Rasolt, Fisher, and Stephan). The crossover results obtained by them are shown to follow from two successive renormalization group transformations. 5 refs.

46586 (IC—86/369) Higher derivative super Yang-Mills theories. Bergshoeff, E.; Rakowski, M.; Sezgin, E. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703086.

The most general higher derivative Yang-Mills actions of the type (F/sup 2/+α2F/sup 4/) which are globally supersymmetric up to order α/sup 2/ in six and ten dimensional spacetimes are given. The F/sup 4/-terms turn out to occur in the combination α/sup 2/(tr F/sup 4/ - 1/4(tr F/sup 2/)/sup 2/), where the trace is over the Lorentz indices. This result agrees with the low energy limit of the open superstring in ten dimensions, where α is the string tension. Surprisingly, the transformation rules of the Yang-Mills multiplet receive order α/sup 2/ corrections even in the off-shell formulation. For the case of Abelian Yang-Mills group, the action is expressed in Born-Infeld form with a metric generically given by (1+α/sup 2/F/sup 2/+...). 9 refs.

46587 (IC—86/377) Irreducible *-representations of the Lie superalgebra osp(1,4) with finite-degenerated vacuum. Blank, J.; Havlicek, M. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87703089.

The method presented previously is applied to the Lie superalgebra B(0,2). A family of irreducible *-representations of this superalgebra and its real form osp(1,4) in terms of differential operators is obtained, the dimension of the vacuum subspace of π/sub J/ being J+1. Reduction with respect to the subalgebra sp(4,IR) approx.= so(3,2) is performed: the representation π/sub O/ reduces into three irreducible representations of so(3,2), whereas all the other π/sub J/ into two. 12 refs.

46588 (IC—86/378) On the relevance of some constructions of highest weight modules over (Super-) Kac-Moody algebras. Dobrev, V.K. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703090.

We correct and improve results of Wakimoto on the (ir)reducibility of his construction of A/sub 1//sup (1)/ highest weight modules (HWM). For a very large class of (super-) Kac-Moody algebras we argue that such a HWM is most relevant when it is isomorphic to a proper factor-module of the corresponding reducible Verma module with the same highest weight. In the same situation we present a general procedure to check the reducibility of the HWM in consideration. 14 refs.

46589 (IC—86/400) Superconformal invariance and superstring in background fields. Aldazabal, G.; Hussain, F.; Zhang, R. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703097.

We consider the propagation of the superstring on a general classical background containing the effects of the metric, the antisymmetric tensor and the dilaton fields. Using the operator product expansion method for two dimensional superconformal field theories we derive the equations for these fields as a consequence of the superconformal invariance of the theory. 19 refs, 4 figs.

46590 (IC—86/403) On the cosmological constant in the heterotic string theory. Gava, E.; Iengo, R. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703099.

We examine the possible physical assumptions which can be made in the heterotic string theory in order to derive the vanishing of the cosmological constant within the theory of modular forms on the moduli space. It seems that more mathematical information is needed to reach a definite result. 13 refs.

46591 (LA—11056-T) A search for the C-noninvariant decay $\pi 0$ yields 3γ. McDonough, J. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 149p. Los Alamos National Lab., P.O. Box 1663, Las Alamos, NM 87545. File Number TI87013522.

A new experimental search for the C-violating decay $\pi^0 \rightarrow 3\gamma$ has been undertaken using the Crystal Box detector at the Clinton P. Anderson Meson Physics Facility (LAMPF). The observation of this decay mode would indicate that the electromagnetic interaction of hadrons is not invariant under charge conjugation. No 3γ events in excess of background were observed. The 90% confidence level upper limit for the 3γ branching ratio is lowered to 3.1×10^{-8}.

46592 (LA-UR—87-2574) T-violating effects in neutron physics and CP-violation in gauge models. Herczeg, P. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 31p. (CONF-8704152—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE87013176.

From Workshop on tests of time reversal invariance in neutron physics; Chapel Hill, NC, USA (17 Apr 1987).

Discussed in this paper is the subject of T-violation in the transmission of polarized neutrons through polarized and oriented targets. Considered is the possible size of the T-violating effects both from a phenomenological point of view, and also in gauge models with CP-violation. A brief discussion of T-violating effects in β-decay is included.

46593 **(UWThPh—1987-10) CP violating phenomena and theoretical results.** Grimus, W. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 140p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87703132.

An introduction to CP violating phenomena is given and the standard model and its most popular low energy extensions in this context are reviewed. The discussion comprises the minimal supersymmetric extension of the standard model, left-right symmetry, the standard model with more than one Higgs doublet and gauged horizontal symmetries.

46594 **On the prospects of observing CP violation in bottom and charm decays.** Bigi, I.I. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 857-861 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

A review is given on the phenomenology of CP violation in B and D decays that has been developed over the last few years. Since a firm data base on B decays is still lacking, semiquantitative scenarios are drawn. Within the Standard Model one predicts asymmetries that can be as large as O (10%) with a confidence level that ranges between hopeful and considerable. Even so, millions of produced B and D mesons are required to make such studies feasible. A B factory would be crucial in such an endeavor.

46595 **Twisted strings and orbifolds.** Bagger, J.A. (The Institute for Advanced Study, Princeton, NJ 08540). pp 341-345 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Orbifold compactifications provide a practical approach to string symmetry breaking. They have the potential to bridge the gap between string theory and the physics of the standard model.

46596 **CP violation and weak decays of quarks and leptons.** Gilchriese, M.G.D. (Lab. of Nuclear Studies, Cornell Univ., Ithaca, NY 14853). pp 140-165 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Recent experimental results on CP violation, tau decays and weak decays of light and heavy quarks are reviewed. Although there are a number of puzzles and discrepancies among experimental results, definitive disagreements with the predictions of the standard electroweak model do not exist.

46597 **Supersymmetry and superconductivity.** Nanbu, Y. (Univ. of Chicago, IL). pp 3-13 of Rationale of beings: Recent developments in particle, nuclear and general physics. Ishikawa, K.; Kawazoe, Y.; Matsuzaki, H.; Takahashi, K. Teaneck, NJ; World Scientific Pub. Co. (1986).

The fermionic and bosonic spectra that follow from a BCS mechanism have a rather simple and universal structure. It is shown, in typical examples, that the effective Hamiltonian that reflects such a structure can be factorized in a way similar to the case of supersymmetric systems. The underlying spectrum generating superalgebras are identified.

6454 Field Theory

REFER ALSO TO CITATION(S) 46390, 46571, 46572, 46595, 46833, 46838

46598 **(CONF-870632—1) The m($A1^{++}$)/m(E^{++}) mass ratio from lattice gauge theory.** Berg, B.A. (Florida State Univ., Tallahassee (USA). Dept. of Physics). 30 Jul 1987. Contract FG05-87ER40319;FC05-85ER25000. 7p. (FSU-SCRI—87-41). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014138.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

Evidence is presented that, in the infinite volume continuum limit, the m($A1^{++}$) and the m(E^{++}) mass are almost degenerate. (A slightly lower $A1^{++}$ mass is preferred.) $A1^{++}$ and E^{++} are irreducible representations of the cubic group and supposed to correspond to spin 0^{++} and 2^{++}, respectively.

46599 **(CONF-8609142—8) Finite size scaling and lattice gauge theory.** Berg, B.A. (Florida State Univ., Tallahassee (USA). Dept. of Physics). 18 Dec 1986. Contract FG05-87ER40319;FC05-85ER25000. 34p. (FSU-SCRI—86-89). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014139.

From Lattice gauge theory meeting; Upton, NY, USA (15 Sep 1986).

Finite size (Fisher) scaling is investigated for four dimensional SU(2) and SU(3) lattice gauge theories without quarks. It allows to disentangle violations of (asymptotic) scaling and finite volume corrections. Mass spectrum, string tension, deconfinement temperature and lattice β-function are considered. For appropriate volumes, Monte Carlo investigations seem to be able to control the finite volume continuum limit. Contact is made with Luescher's small volume expansion and possibly also with the asymptotic large volume behavior. 41 refs., 19 figs.

46600 **(FNAL/Pub—87/112-A) Quark matter in the Hartree-Fock approximation.** Grassi, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1987. Contract AC02-76CH03000. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013479.

An equation of state is computed for quark matter interacting through a phenomenological potential in the Hartree-Fock approximation. It is shown that for color-independent confining potentials, it can be approximated by the Hartree result and leads to a first order mass phase transition. For color-dependent confining potentials, a phase transition from a Fermi sphere to a Fermi shell is possible.

46601 **(IC—86/320) Soft photon radiation effects in monopole processes.** Blagojevic, M. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703069.

The infrared problem of the quantum field theory of monopoles and charges is reviewed and discussed in explicit terms. It is shown that the related radiation effects yield a superstrong damping of the cross-section in the relativistic kinematic region, which leads to a possible mechanism for partial monopole confinement. 24 refs, 8 figs.

46602 **(IC—86/341) Quantum electrodynamics based on self-energy, without second quantization: The Lamb shift and long-range Casimir-Polder van der Waals forces near boundaries.** Barut, A.O.; Dowling, J.P. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703075.

Using a previously formulated theory of quantum electrodynamics based on self-energy, we give a general method for computing the Lamb shift and related Casimir-Polder energies for a quantum system in the vicinity of perfectly conducting boundaries. Our results are exact and easily extendable to a full covariant relativistic form. As a particular example we apply the method to an atom near an infinite conducting plane, and we recover the standard

QED results (which are known only in the dipole approximation) in a simple and straight forward manner. This is accomplished in the context of the new theory which is not second quantized and contains no vacuum fluctuations. 37 refs.

46603 **(IC—86/342) Regular effective action of gauge field theory and quantum gravity.** Baaklini, N.S. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 60p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87703076.

We present a perturbative formalism for the effective quantum action of a general Fermi-Bose field theory. We propose a unitary alternative to the conventional virtual ghost prescription for handling the functional integral of gauge fields, based on the functional space metric that is determined by the Dirac brackets of the Canonical theory. A gauge-invariant Gaussian cutoff is introduced by extending the functional space metric into a regular counterpart. The regular one-loop contributions of a scalar field to the photon and the graviton self-energies are computed. The otherwise logarithmically divergent contributions are found, in our scheme, to be independent of cutoff. 17 refs.

46604 **(IC—86/375) Schwinger models in arbitrary gauges and at finite temperature.** Thompson, G.; Zhang, R. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703088.

The Schwinger model is solved in an arbitrary gauge and for any temperature. 9 refs.

46605 **(IC—86/397) Bosonization in a two-dimensional Riemann Cartan geometry.** Denardo, G.; Spallucci, E. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703096.

We study the vacuum functional for a Dirac field in a two dimensional Riemann-Cartan geometry. Torsion is treated as a quantum variable while the metric is considered as a classical background field. Decoupling spinors from the non-Riemannian part of the geometry introduces a chiral Jacobian into the vacuum generating functional. We compute this functional Jacobian determinant by means of the Alvarez method. Finally, we show that the effective action for the background geometry is of the Liouville type and does not preserve any memory of the initial torsion field. 20 refs.

46606 **(IC—86/402) O(5) x U(1) electro-weak gauge theory and the neutrino oscillations.** Samiullah, M. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703098.

In the present study we have employed the group O(5)xU(1). The left-handed leptons L/sub L//sup T/=(ν/sub e/ ,e,μ,ν/sub μ/)/sub L/ and the quarks Q/sub L//sup T/=(u,d,s,c)/ sub L/ are assigned to the four-dimensional representation of O(5). The righthanded particles are taken to be the singlets of the group. The group is safe and economical in the number of gauge bosons which we associate with each of its generators. We have achieved the quark mixing by introducing the Cabibbo angle through mixing of the additional gauge bosons as compared to the CWS model. Consistency of our work demands a simultaneous Cabibbo rotation of the neutrino fields along with the quarks d and s. Thus the neutrino oscillation angle turns out to be the Cabibbo angle. Using experimental results of Baker et al. we have set an upper limit on Δm/sup 2/ <= 1.3 ev/sup 2/. 10 refs.

46607 **(INIS-mf—10698) Quaternionic non Abelian relativistic quantum fields in four dimensions.** Albeverio, S.; Hoeegh-Krohn, R. (Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS); Bochum Univ. (Germany, F.R.); Oslo Univ. (Norway)). 1986. 16p. NTIS, PC E07; Available from NTIS as TIB/B87-10276.

BiBoS.; No. 239/86.

We give a simple construction of certain Lie-group valued Euclidean Markov random fields and quantum fields in four dimensions. These fields can be looked upon as non Abelian extensions of electromagnetic fields.

46608 **(KFKI—1986-69/A) Θ-sectors in the OS-construction.** Szlachanyi, K.; Vecsernyes, P. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Oct 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87703117.

By enlarging the functional space to include nonlocal fields which are sensitive to the space-time asymptotics of the configurations the Θ-sectors in the OS-Hilbert space were formally constructed. The question of inequivalence of the different Θ-sectors was studied on two quantum mechanical examples and in the case of non-Abelian gauge theories. 5 refs.

46609 **(KFKI—1987-01/A) Nonperturbative approach to quark propagator in the covariant, transverse gauge.** Gogokhia, V.Sh.; Magradze, B.A. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703122.

Schwinger-Dyson equation for the quark propagator is investigated in the infrared region. Confinement is implemented in two different ways, assuming that the gluon propagator in covariant, transverse gauge becomes infrared singular like q/sup -4/ and δ/sup 4/(q) at small momenta, respectively. Slavnov-Taylor identity is used to fix the low-energy behaviour of the corresponding quark-gluon vertex function. In both cases nonlinear differential equation systems were obtained for the quark propagator. Two different groups of solutions were found, but all possible solutions proved to be of confinement-type. 30 refs.

46610 **(LBL—23440) Anomalies in gauge theories.** Hwang, Dae Sung. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 56p. (UCB-PTH—87/20). NTIS, PC A04. File Number DE87014087.

In a situation where a symmetry at the classical level is not a symmetry at the quantum level, the amount by which an effective action violates the symmetry, if it cannot be removed by adding a local functional to the effective action, is called an anomaly. Various topics of anomalies in two dimensions are studied. Topics covered include the anomalies of Yang-Mills gauge theory, gravitational theory, and supersymmetric gauge theory. The solution of the anomaly equation (the Wess-Zumino term) is obtained with only gauge fields, without auxiliary fields. A method is found to obtain the anomaly of the chiral current from the Schwinger terms of the equal time commutation relations. In the study of gravitational anomaly, Feynman diagrams are calculated to get an effective action, and it is shown, up to the second non-trivial order, that this effective action is in agreement with the anomaly obtained by the differential geometric method. A supersymmetric extension of the gauge anomaly is obtained, and it is shown that this is the origin of a supersymmetry anomaly in the Wess-Zumino gauge. An effective action whose variations give rise to the gauge and supersymmetry anomalies in the Wess-Zumino gauge is obtained. (LEW)

46611 **(LBL—23573) Probing the W-Z-Higgs sector of electroweak gauge theories at the superconducting super collider.** Gunion, J.F. (Lawrence Berkeley Lab., CA (USA); California Univ., Davis (USA). Dept. of Physics). Oct 1986. Contract AC03-76SF00098. 14p. (CONF-8606215—44). NTIS, PC A02. File Number DE87014022.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

We review and summarize the procedures for exploring at the SSC the W-Z-Higgs sector of SU(2)/sub L/ x U(1) and extended gauge theory versions thereof, including supersymmetric and left-right symmetric models.

46612 **(SLAC-PUB—4352) An introduction to charm and heavy quark physics.** Gilman, F.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1987. Contract AC03-76SF00515. 46p. (CONF-8706185—1). NTIS, PC A03. File Number DE87013589.

From Charm physics symposium; Beijing, China (4 Jun 1987).

The physics of the electroweak and strong interactions in the standard model are reviewed, especially as they apply to the tau lepton and to charm and heavy quark physics.

46613 **(UWThPh—1987-08) Quantization of fermions in external soliton fields.** Grosse, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703131.

Recent results on representations of the canonical anticommutation relations, implementability of gauge transformations, calculation of the algebra of charges and determination of a ground state charge, which may become fractional, are reviewed.

46614 **(UWThPh—1987-11) Finite quantum field theories and supersymmetry.** Lucha, W.; Neufeld, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703133.

We discuss the consequences of requiring finiteness for a general renormalizable quantum field theory.

46615 **Tabulation of astrophysical constraints on axions and Nambu-Goldstone bosons.** Cheng, H. (Physics Department, Indiana University, Bloomington, Indiana 47405). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 6, 1649-1656(15 Sep 1987).

Astrophysical constraints on the couplings of light and weakly coupled pseudoscalar particles (axions, Majorons, familons, ...) from considerations of various stellar objects are summarized. We tabulate the astrophysical bounds on the mass and the decay constant of Dine-Fischler-Srednicki-Zhitnitsky (DFSZ) axions and Kim-Shifman-Vainshtein-Zakharov (KSVZ) axions, on the triplet Majoron vacuum expectation value v/sub T/, and on the familon breaking scale. The lower bound of the Peccei-Quinn breaking scale in the KSVZ model is generally one order of magnitude weaker than that in the DFSZ model. The most stringent limit on v/sub T/<2 keV is obtained from considerations of Majoron emission from the cores of neutron stars. Bounds on the strength of the 1/r potential mediated by Gelmini-Roncadelli Majorons are also given.

46616 **Vacuum state of complex scalar fields in SO(2,1)-invariant backgrounds.** Floreanini, R.; Vinet, L. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 6, 1731-1739(15 Sep 1987).

We consider complex scalar fields in two-dimensional de Sitter space minimally coupled to an SO(2,1)-invariant Maxwell potential and construct an ultraviolet-finite functional representation of the symmetry generators in the Schroedinger picture. We find that there is a unique vacuum state which is strictly SO(2,1) invariant.

46617 **Renormalization versus the Gaussian effective potential.** Wudka, J. (The Harrison M. Randall Laboratory of Physics, The University of Michigan, Ann Arbor, Michigan 48109). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 6, 1745-1753(15 Sep 1987).

In this paper we study the variational upper bounds to the effective potential with the proper inclusion of all renormalization effects. We find that the Gaussian effective potential is well defined in $1+1$ dimensions but not so for higher dimensionalities. This problem, and possible ways of evading it, are discussed to some extent. All calculations are performed in the Schroedinger representation.

46618 **String field theory at finite temperature.** Leblanc, Y. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 6, 1780-1793(15 Sep 1987).

We present a real-time formalism enabling us to compute statistical averages of various quantum string field correlation functions and scattering amplitudes in the context of perturbation theory and functional methods. Second quantization of the string fields is carried out in the path-integral representation. Our finite-temperature formalism is a generalization of thermo field dynamics to string field theory for which a doubling of the physical string field degrees of freedom is required. Temperature formally enters our construction by imposing boundary conditions (Kubo-Martin-Schwinger condition) in the generating functional for the string field. Some explicit computations for the case of covariant open bosonic string theory are carried out.

46619 **Quantum electrodynamics in the temporal gauge.** Haller, K. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 6, 1830-1838(15 Sep 1987).

A canonical formulation is given for quantum electrodynamics in the temporal gauge. A procedure is developed for implementing the gauge-fixing condition $A_0 = 0$ and Gauss's law as time-independent constraints. The resulting formalism is shown to be physically equivalent to quantum electrodynamics in the Coulomb and Lorentz gauges. It is demonstrated that photon ghosts are appropriate for the representation of the longitudinal vector potential. Propagators for the longitudinal vector potential are derived and compared to results obtained by other authors. Implications for quantum chromodynamics are discussed.

46620 **Yang-Mills theory and quantum chromodynamics in the temporal gauge.** Haller, K. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 6, 1839-1845(15 Sep 1987).

A canonical formulation is given for Yang-Mills theory and quantum chromodynamics in the temporal gauge. Operator constraints are avoided so that canonical commutation rules apply throughout. The use of ghost operators for longitudinal and time-like gluons permits the selection of states that obey the gauge-fixing condition and Gauss's law as time-independent constraints. Propagators for longitudinal gluons are evaluated and an argument is given in support of the conclusion that the part of the propagator that violates time-translation invariance has no effect on perturbative S-matrix elements. The validity of asymptotic free-field representations for quarks and gluons in perturbative S-matrix calculations is related to the Lie algebra that characterizes the gauge theory.

46621 **Universal W,Z scattering theorems and no-lose corollary for the SSC.** Chanowitz, M.S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 445-449 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The experimentally verified relationship M/sub w/ = M/sub z/ cos θ/sub w/ implied that the physics underlying electroweak symmetry breaking must become visible at or below 1 TeV in the following sense, either there are spin zero bosons much lighter than 1 TeV or there are enhanced cross sections for W, Z pair production. The latter enhancements would signal a new sector of strongly interacting particles at the 1 TeV scale or higher and could be observed at the SSC even if the associated new spectrum were so much heavier than 1 TeV that it could not be produced and studied directly.

46622 **Phenomenological aspects of unified theories.** Peccei, R.D. (DESY, D-2000 Hamburg). pp 3-24 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author briefly discusses two new phenomena of recent interest, the 5/sup th/ force and variant axions. The former, for its elucidation, will require further gravitational experiments, but the author concludes that variant axions are now definitely rules out experimentally. Various aspects of superstring phenomenology are then addressed, including some of the generic predictions of su-

perstrings and some of its generic problems. In particular, he discusses some of the phenomenological consequences of having an extra Z^0 boson and the circumstances under which this excitation is a genuine prediction of superstrings. Since it is likely that a more reliable relic of superstrings will be provided by the presence of superpartners at low energy ($\leq$ TeV), he discusses some of the bounds for squarks and gluinos obtained at the SppS collider and the expectations for their production at the Tevatron. As a final topic, he touches upon some of the consequences that result from having the Fermi scale arise from an underlying theory. Some aspects of the composite Higgs model and of the strongly coupled standard model are briefly reviewed.

46623 **Studies of chiral symmetry in a spontaneously broken lattice gauge theory.** Lee, I.H. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 577-580 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The phase diagram of lattice SU(2) gauge theory with fundamental representation Higgs field is probed by l = 1/2 and l = 1 fermions. Quenched calculations of (psi-barpsi)l show two distinct regions characterized by broken or unbroken chiral symmetry. The location of the boundary between the two regions depends on the representation l of the fermions. For l = 1/2 fermions, the author has verified the presence of Nambu-Goldstone bosons ("pions") in the region where chiral symmetry is broken and have found evidence for massless physical fermions in the chirally symmetric region.

46624 **Status of the Columbia lattice parallel processor project.** Brown, F.R. (Dept. of Physics, Columbia Univ., New York, NY 10027). pp 566-569 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author reviews the status of the Columbia Lattice Parallel Processor project, in which parallel processing hardware with high performance floating point capability is used to perform large scale Monte Carlo studies of QCD. The project encompasses three stages; a 16-node machine with a nominal peak speed of 256 Mflops, a 1 Gflop 64-node machine, and a 16 Gflop 256-node machine. The 16-node machine was completed in April 1985, and has been employed since that time for the study of deconfinement in the pure gauge theory. The 64-node machine is under construction. The prototype node was completed in June 1986 and has successfully run a Monte Carlo program. Completion is expected by the end of 1986. The 256-node machine is now in the design stage. The modularity of the design makes evolutionary improvement of the vector processor relatively painless. This modularity together with the latest generation of floating point chips makes possible a very exciting aspect of the 256-node design, namely, a single node peak speed of 64 Mflops.

46625 **Harmonic superspace formalism and the consistent Chiral anomaly.** Li, W. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 410-412 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The harmonic superspace formalism has been used to construct the consistent chiral anomaly in N = 1, d = 6 supersymmetric Yang-Mills theory. The expressions of the gauge anomaly Δ/sub s//sup phi/ and of the supersymmetric anomaly Δ/sub SUSY//sup phi/ are given together with the consistent condition.

46626 **Top quark and light Higgs scalar mass bounds in no-scale supergravity.** Roy, P. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 387-389 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

No-scale supergravity theories with the minimal low-energy particle content are shown to become untenable for a top quark mass m/sub T/ much less than 40 GeV. For m/sub T/ $<$ 55 GeV, a stringent upper bound operates on the mass of the lowest-lying Higgs scalar. Further, the Higgs pseudoscalar is constrained to be nearly a quarter as massive as the gluino.

46627 **Operator formulation of Wittens string field theory.** Jevicki, A. (Physics Dept., Brown Univ., Providence, RI 02912). pp 351-355 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The author summarizes some recent developments on the construction of gauge invariant string field theory. The approach is based on Wittens differential geometric description of interactions and symmetries. He presents the explicit construction of the interaction vertex and discuss its properties.

46628 **Superstrings.** Schwartz, J.H. (California Institute of Technology, Pasadena, CA 91125). pp 105-116 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

String theories are promising candidates for perturbatively finite quantum theories of gravity. Mathematical consistency appears to require a supersymmetric theory in ten dimensions with gauge group E/sub 8/xE/sub 8/ or SO(32). The E/sub 8/xE/sub 8/ theory may be capable, after spontaneous compactification of six dimensions, of producing realistic low-energy physics. Superstring theory is developing very rapidly in the last year, but it will probably take a long time to make a convincing case that this is the route that nature has chosen.

46629 **Conformal invariance on Calabi-Yau spaces.** Nemeschansky, D. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 366-368 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—). Contract AC03-76SF00515.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The possibility of superstring compactification on Calabi-Yau manifolds is analyzed. Despite the apparent non-zero β function at four loop order, it is possible to construct a conformally invariant sigma model on a Calabi-Yau manifold. The background metric is not Ricci flat, but is related to the Ricci flat metric through a (non-local) field redefinition.

46630 **Feeble forces.** Bars, I.; Visser, M. (Physics Dept., Univ. of Southern California, Los Angeles, CA 90089-0484). pp 1032-1037 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The authors discuss a scenario for obtaining extremely weakly coupled vector bosons from a variant of Kaluza-Klein theory. The proposed mechanism provides a natural framework for

the discussion of possible deviations from Newtonian gravity - deviations similar to those reported recently as a "fifth force."

46631 **Is the superstring semiclassical.** Dine, M.; Seiberg, N. (Institute for Advanced Study-Princeton, NJ 08540). pp 678-691 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—).

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

The various coupling constants and scales of the superstring are analyzed. Simple general considerations and an explicit calculation show that if the superstring is to describe our world, it is probably strongly coupled. Certain loopholes to the argument are discussed.

46632 **Gauge invariance of string fields.** Banks, T. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 621-634 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—). Contract AC03-76SF00515.

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

This report is presented to clarify the appearance of gauge bosons and gravitons in string theories. Free (bosonic) string field theory is invariant under an infinite set of gauge transformations which include Yang-Mills transformations and general coordinate transformations as special cases. The work was motivated by papers in which a covariant, gauge fixed free string action was constructed. The end of the report shows how to obtain action from a straightforward application of the Faddeev-Popov procedure. Two other groups have independently arrived at the form for the gauge invariant string action that is presented here.

46633 **Gauge invariant string actions.** Zwiebach, B. (Dept. of Physics, Univ. of California, Berkeley, CA 94720). pp 607-620 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—).

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

The main ideas behind the recent construction of the gauge invariant string free actions starting from BRST formulations are reviewed and examined in detail.

46634 **Torsion in superstrings.** Bars, I.; Nemeschansky, D.; Yankielowicz, S. (Dept. of Physics, Univ. of Southern California, Los Angeles, CA 90089-0484). pp 522-532 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—).

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

In this paper the authors discuss string theories on a background manifold with torsion. In the first part, candidate vacuum configurations for ten-dimensional superstrings are discussed. The authors compactify these on M/sub 4/xK, where M/sub 4/ is four-dimensional and K some compact six-dimensional manifold. In particular they are interested in investigating the existence of solutions with non-zero torsion on K. The compactification problem is approached both from the effective field theory point of view and directly using string considerations. The second part of the talk is devoted to the construction of string theories in curved space with torsion. The authors discuss both the Neveu-Schwarz-Ramond type string and the Green-Schwarz type string. Particular emphasis is put on the resulting constraints on space-time supersymmetry in the Green-Schwarz approach. This study uses two-dimensional nonlinear sigma models to describe the propagation of strings in background geometries with torsion. The background field can be understood as arising from condensation of infinite number of strings.

46635 **σ model approach to the heterotic string theory.** Sen, A. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 497-506 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—). Contract AC03-76SF00515.

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

Relation between the equations of motion for the massless fields in the heterotic string theory, and the conformal invariance of the σ model describing the propagation of the heterotic string in arbitrary background massless fields is discussed. It is emphasized that this σ model contains complete information about the string theory. Finally, the extension of the Hull-Witten proof of local gauge and Lorentz invariance of the σ-model to higher order in α', and the modification of the transformation laws of the antisymmetric tensor field under these symmetries are discussed. Presence of anomaly in the naive N = 1/2 supersymmetry transformation is also pointed out in this context.

46636 **Introduction to two dimensional conformal and superconformal field theory.** Shenker, S.H. (Enrico Fermi and James Franck Institutes, and Dept. of Physics, Univ. of Chicago, Chicago, IL 60637). pp 141-161 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—).

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

Some of the basic properties of conformal and superconformal field theories in two dimensions are discussed in connection with the string and superstring theories built from them. In the first lecture the stress-energy tensor, the Virasoro algebra, highest weight states, primary fields, operator products coefficients, bootstrap ideas, and unitary and degenerate representations of the Virasoro algebra are discussed. In the second lecture the basic structure of superconformal two dimensional field theory is sketched and then the Ramond Neveu-Schwarz formulation of the superstring is described. Some of the issues involved in constructing the fermion vertex in this formalism are discussed.

46637 **Differential geometry in string models.** Alvarez, O. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 103-140 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—). Contract AC03-76SF00098.

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

In this article the author reviews the differential geometric approach to the quantization of strings. A seminal paper demonstrates the connection between the trace anomaly and the critical dimension. The role played by the Faddeev-Popov ghosts has been instrumental in much of the subsequent work on the quantization of strings. This paper discusses the differential geometry of two dimensional surfaces and its importance in the quantization of strings. The path integral quantization approach to strings will be carefully analyzed to determine the correct effective measure for string theories. The choice of measure for the path integral is determined by differential geometric considerations. Once the measure is determined, the manifest diffeomorphism invariance of the theory will have to be broken by using the Faddeev-Popov ansatz. The gauge fixed theory is studied in detail with emphasis on the role of conformal and gravitational anomalies. In the analysis, the path integral formulation of the gauge fixed theory requires summing over all the distinct complex structures on the manifold.

46638 **Introduction to the theory of relativistic strings.** Thorn, C.B. (Dept. of Physics, Univ. of Florida, Gainesville, FL 32611). pp 5-45 of Unified string theories. Green, M.; Gross, D. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-850798—).

From Workshop on unified string theories; Santa Barbara, CA, USA (29 Jul 1985).

The author presents detailed information with the appropriate equations given as a solution leading to the usual perturbation theory with nonperturbative phenomena encoded. He concludes with a discussion of the "classical" by which he means zero loop approximation to interacting string theory. He discusses the systematic limit that involves large field strengths. The author believes that the bosonic string is probably of academic interest only but should apply such studies to the super string.

46639 Constraining the standard model with a supergroup. Ne'eman, Y. (Tel Aviv Univ., Tel Aviv). pp 14-28 of Rationale of beings: Recent developments in particle, nuclear and general physics. Ishikawa, K.; Kawazoe, Y.; Matsuzaki, H.; Takahashi, K. Teaneck, NJ; World Scientific Pub. Co. (1986).

The author has introduced in this paper the conjecture that the δμ(2/1) superalgebra transitions relate particle fields to ghost fields, of the type introduced by Feynman, DeWitt, Faddeev and Popov to ensure the Unitarity of Quantized Gauge Theories. δμ(2/1) thus resembles the Becchi-Rouet-Stora and the Curci-Ferrari algebras, also relating particle and ghost fields, and providing algebraic shortcuts, simplifying the imposition of Unitarity throughout the renormalization procedure. However, the author has also noted that for the spin 1/2 (matter) fields, the grading of the carrier vector-spaces is correlated with chirality. Indeed, the author has proved elsewhere that the (reducible) matrices representing U(2)/sub w/ x SU(3)/sub color/, when acting on supermultiplets constructed from juxtapositions of independent matter multiplets and graded according to chirality (thus disregarding Lorentz invariance in that auxiliary construction) have vanishing supertraces. Coming back to the statistics of the submultiplets in the matter representations, the author notices that μ/sub q/ of equation is proportional to the helicities of the leptons whose (y, vertical bar i vertical bar, i/sub 3/) quantum numbers are given by the above representations. Thus, the grading in δμ(2/1) coincides with helicity. The left-handed leptons are assigned to (-1, 1/2+), the left-handed quarks to (1/3, 1/2/sup +/); their right-handed antiparticles belong to (1, 1/2/sup +/) and (-1/3,1/2/sup +/).

46640 Microcanonical quantization and its applications. Iwazaki, A. (Univ. of California, Berkeley, CA 94720). pp 118-127 of Rationale of beings: Recent developments in particle, nuclear and general physics. Ishikawa, K.; Kawazoe, Y.; Matsuzaki, H.; Takahashi, K. Teaneck, NJ; World Scientific Pub. Co. (1986).

The author discusses microcanonical quantization and its interesting properties and explain our recent proposal for numerical application.

46641 Status of the theory of QCD plasma. Kapusta, J. (Brookhaven National Lab., NY). pp 820-839 of Proceedings of the XV international symposium on multiparticle dynamics. Gustafson, G.; Peterson, C. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406183—). Contract AC02-79ER10364;AC02-76CH00016.

From 15. international symposium on multiparticle dynamics; Lund, Sweden (11 Jun 1984).

There is mounting evidence, based on many theoretical approaches, that color is deconfined and chiral symmetry is restored at temperatures greater than about 200 MeV. The authors present reasonable estimates of the energy density to be expected in high energy heavy ion collisions and suggest that QCD plasma is formed in the laboratory. Proposed experimental signals allow us to infer such quantities as the temperature, the quark dispersion relation, the space-time evolution and, perhaps, even the order of the phase transition.

65 PHYSICS II

REFER ALSO TO CITATION(S) 46343

46642 (BNL—40082) A matter-antimatter propulsion system for manned interstellar flight. Powell, J.R.; Pelligrino, C. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-8710122—1). NTIS, PC A02. File Number DE87013311.

From 38. congress of the International Astronautical Federation; Brighton, UK (10 Oct 1987).

The major problems of interstellar flight are addressed in an integrated design of a star ship, Valkyrie. It employs a large diameter (~1 km) thin superconducting current ring to magnetically channel the reaction products from repetitive pellet explosions (either matter-antimatter or fusion) to generate thrust. The thermal intercept fraction on the star ship is very small, $\sim 10^{-6}$. Waste heat is radiated to space by a droplet radiator, which also protects against interstellar dust/gas. Maximum velocities in the range 10 to 20% of light speed appear possible. 3 refs., 8 figs., 2 tabs.

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 46058, 46932

46643 (DOE/ER/05034—10) Experimental nuclear physics: Progress report, September 1986-July 1987. Hamilton, J.H. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). Aug 1987. Contract AS05-76ER05034. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014586.

The research activities of the experimental nuclear structure group at Vanderbilt University carried out under Contract AS05-76ER05034 with the Department of Energy for the period September 1986 to July 1987 are reported here. Research continues in the areas of (1) in-beam γ-ray spectroscopy including cooperations with scientists at Oak Ridge, Univ. of Rochester, Univ. of Koeln, Louisiana State Univ., Univ. of Florida, Idaho Falls, and Univ. of Notre Dame; (2) studies of nuclei far from stability at UNISOR and at the recoil mass spectrometer at the University of Rochester; (3) nucleon transfer reaction and fusion-fission studies with scientists at ORNL, Argonne National Laboratory, Univ. of Michigan, and University of Kansas; (4) theoretical studies with scientists at Univ. Frankfurt, Univ. Tuebingen, Univ. Lund, Brookhaven, Lawrence Berkeley, and ORNL; (5) other studies. In general, abstracts of papers published or submitted for publication in this period make up this report along with brief reports of work in process and complete copies of a few conference papers.

46644 (DOE/ER/40309—1) Nuclear structure at intermediate energies: Progress report, November 1986-August 1987. Bonner, B.E.; Mutchler, G.S.; Phillips, G.C. (Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.). 1 Sep 1987. Contract FG05-87ER40309. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014236.

The report includes information on prior, current, and future experiments; nuclear theory; and instrumentation. Current experiments include single pion production in np scattering, spin transfer in hyperon production, photoproduction of high p/sub T/jets, and meson studies. Future experiments will continue current research and also include the production of lambda particles with heavy ions and the production of polarized antiproton beams at LEAR. Theoretical research programs are investigating the Gaussian effective potential (GEP), hadron-nucleus scattering as a function of nuclear size, nucleon structure, and exotic contributions to lambda production in pion-deuteron interactions. Instrumentation developments include proportional wire counters, other electronics, and computer systems. 13 refs., 1 tab.

46645 (DOE/ER/40316—1) Studies of complex fragment emission in heavy ion reactions: Progress report, September 1, 1986 through August 31, 1987. Sobotka, L.G. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry). 1987. Contract FG02-87ER40316. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014533.

The production of large fragments, fragments with mass between light particles and fission fragments, in intermediate and high energy nuclear reactions has fostered the proposal of a number of novel reaction mechanisms. These include liquid-vapor equilibrium and nuclear shattering. Temporarily left in the wake of these exciting proposed mechanisms was the old standard, statistical decay of compound nuclei. To be sure, the standard treatment of compound nucleus decay did not deal with large fragment production. However, this omission was not due to any fundamental deficiency of statistical models, but rather an uncertainty concerning exactly how to splice large fragment emission into statistical models. A large portion of our program deals with this problem. Specifically, by studying the yields of large fragments produced in sufficiently low energy reactions we are attempting to deduce the asymmetry and l-wave dependence of large fragment emission from compound nuclear intermediates. This, however, is only half of the problem. Since the novel mechanisms proposed for large fragment emission

were spawned by intermediate and high energy reaction data, we must also realize the relevance of the compound nucleus mechanisms at high energies. It is not unreasonable to suspect that compound nucleus-like objects are formed with less than complete momentum transfer and perhaps less than complete mass transfer. Therefore the study of large fragment production in low energy reactions should go hand in hand with the study of energy, mass, and angular momentum transfer in non-compound reactions. This thread joins the apparently divergent subjects covered in this report. 39 refs., 24 figs., 2 tabs.

46646 **(GSI—87-7) Proceedings of the workshop on experiments and experimental facilities at SIS/ESR.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Apr 1987. 148p. (CONF-8703169—Absts.). NTIS, PC E11; Available from NTIS as TIB/B87-10626.

From Workshop on experiments and experimental facilities at SIS/ESR; Darmstadt, F.R. Germany (30 Mar 1987).

The present proceedings contain the abstracts of the proposals and letters of intent prepared by the authors for general distribution. The abstracts are organized according to the sessions in which they were presented at the workshop. The program of the workshop is also included as is the list of attendees. In addition we have included two recent descriptions of the accelerator facilities providing information on the latest status of the expected beam schedule for SIS and performance characteristics of the ESR. (orig./HSI).

46647 **(GSI—87-30-Prepr.) Proton radioactivity.** Hofmann, S. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jun 1987. 77p. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.

Also published in: Ivascu, M.; Poenaru, D.N. (eds.): Particle emission from nuclei, CRC Press, Boca Raton, FL (USA).

The purpose of the present review is to provide a summary and to make an attempt to connect the observed phenomena to nuclear structure effects which are well investigated for less neutron deficient species but become increasingly scarce approaching the proton drip line. (orig./HSI).

46648 **(KURRI-TR—277) Proceedings of the 2nd specialist research meeting on measurements of short-lived isotopes.** Yoshizawa, Yasukazu; Kawase, Yoichi; Okano, Kotoyuki (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Apr 1986. vp. (In Japanese). (CONF-8602137—). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780156.

From 2. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (4 Feb 1986).

Individual papers have been cataloged separately. (WRF)

46649 **(LBL—22820) Nuclear Science Division: Annual report for the period October 1, 1985-September 30, 1986.** Mahoney, J. (ed.). (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 183p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87013973.

Research has for the most part been carried out using three local accelerators, the Bevalac, the SuperHILAC and the 88-Inch Cyclotron. However, at CERN, oxygen-16 beams were accelerated to 3.2 TeV using the LBL-GSI heavy ion injector into the CERN SPS. First results obtained during the beam test period are presented in this report. Bevalac research has probed new regions of the nuclear matter equation of state. Studies of collisions between the most massive nuclei have revealed rich new phenomena such as collective flow, where the pressures generated force the emerging particles away from the beam direction. Experiments on dileptons (e^+e^- pairs) utilizing the newly completed Dilepton Spectrometer (DLS) are being carried out to glean new insights into the hot, high-density stage of the collision. Major new results on the nuclear structure of exotic, very neutron-rich light nuclei are being obtained by exploiting the projectile fragmentation process to produce secondary radioactive beams. The Laboratory has proposed the Bevalac Upgrade Project to replace the Bevalac's weak-focusing synchrotron with a modern, strong-focusing synchrotron to provide higher intensity and higher quality beams. The significant enhancement of the heavy ion capability at the 88-Inch Cyclotron as a result of the recent development of the ECR source has led to a renaissance of the cyclotron as indicated by the increased demand for beam time. A variety of other scientific activities were also carried out during this period. The Isotopes Project published the first edition of a new radioactivity reference book for applied users-The Table of Radioactive Isotopes and division members organized several major scientific meetings.

46650 **(NAC—85-03) Considerations for the initial production of /sup 123/I at the NAC.** Nortier, F.M.; Steyn, G.F.; Mills, S.J.; Rautenbach, W.L. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1985. 9p. CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

The /sup 127/I(p,5n) /sup 123/Xe reaction is evidently the best choice for the routine production of /sup 123/I at the NAC. The lack of detail information and local experience of this specific production method, makes the choice of technique and target material rather difficult. An on-line target has the advantage of negligible radioactive waste and minimal radiation dose to personnel because of the abscence of unnecessary handling of irradiated material. Because of its successfull applications at other places, it is clear that the NAC should eventually make use of an on-line target as well. In contrast, the batch process, although having the unavoidable radioactive waste problem, offers a simpler target design and would therefore require less development time. It may be advantageous to concentrate initially on developing the batch process with a sodium iodide tablet as target material in order to satisfy the current demand for /sup 123/I, at the same time gaining important experience.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 46053, 46666

46651 **(DOE/ER/04449—58) Study of the neutron-proton interaction in the 300-700 MeV energy region: Annual progress report, 1986-87.** Northcliffe, L.C. (Texas A and M Univ., College Station (USA)). 1987. Contract AS05-76ER04449. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012474.

This report concerns recent experiments in nuclear physics. The transverse spin-correlation parameter A/sub NN/(θ) was measured for elastic neutron-proton scattering at 800 MeV. Much data was gathered and is presently being analyzed. (LEW)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

46652 **(JINR—E-15-86-216) Charge symmetry violation in the /sup 2/H(d,n-vector)/sup 3/He and /sup 2/H(d,p-vector)/sup 3/H reactions.** Kozma, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703112.

Precision measurement of the angular distribution of polarized protons from the /sup 2/H(d,p)/sup 3/H reaction at about 1 MeV is compared with experimental data of the neutron polarization in the mirror reaction /sup 2/H(d,n)/sup 3/He at the same entrance and exit channel energies. In both comparisons the differences in polarizations of nucleons from d+d charge-symmetryc reactions are found to be larger than experimental errors. 12 refs.; 3 figs.

46653 **(RCNP-P—81) Report of study meeting on minority many body system.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Mar 1986. 107p. (In Japanese). (CONF-8511299—Summ.). NTIS (US Sales Only), PC A06/MF A01. File Number DE87703017.

From Study meeting on minority many body system; Ibaraki, Japan (12 Nov 1985).

This book is the report of the study meeting on minority many body system held from November 12 to 13, 1985, in the Research Center for Nuclear Physics, Osaka University. The objective

of this study meeting was to discuss widely from theoretical and experimental viewpoints the problems of minority many body system in a low energy region such as various experimental studies of three and four nucleon systems and multiple particle emission reaction in nuclear reaction, making no bones of a narrow limit such as Faddeev's theory and its verification. In this book, the gists of 18 papers are collected. (Kako, I.).

6513 Nuclear Properties And Reactions, A=6-19, Experimental

46654 (BNL—40074) Kaon-nucleus reactions and hypernuclei. Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 18p. (CONF-8706166—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014283.

From International symposium on medium energy physics; Beijing, China (23 Jun 1987).

Recent advances in hypernuclear physics and kaon-nucleus scattering are discussed, with emphasis on the spectroscopy of Λ single particle states in heavy systems, as revealed by the (π^+,K^+) reaction. 26 refs., 8 figs.

46655 (BNL—40157) Spin-spin and isospin interactions from capture measurements. Mughabghab, S.F. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 3p. (CONF-8708101—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014396.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

A reanalysis of the ^{9}Be(n,γ)^{10}Be data yields a revised value of 1.25 +- 0.15 MeV for the spin-spin potential, V/sub Iσ/. Other evidence for such a term is derived from ^{10}B(n,γ)^{11}B where V/sub Iσ/ = 1.6 +- 0.6 MeV. The Lane isovector symmetry potential is determined from ^{48}Ca(n,γ)^{49}Ca where W/sub D/ = 11.3 - 67.8 ((N - Z)/A) MeV.

46656 (JINR—R-1-86-109) Angular dependence of slope parameters of invariant inclusive cumulative hadron production cross section in pC-interactions at 10 Gev/c and in π/sup -/C-interactions at 40 Gev/c. Kopylova, D.K.; Lyubimov, V.B.; Nikitina, V.F.; Togoo, R.; Tuvdendorzh, D.; Sherkulov, U.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703114.

Invariant inclusive cross sections of π/sup -/-mesons and proton cumulative production from pC- and π/sup -/C-interactions (P/sub P/=10 GeV/c, P/sub π/=40 GeV/c) for five intervals of the back hemisphere angles in the laboratory coordinate system have been investigated on the images from the 2 meter propane bubble chamber. It has been found that the angular dependence of parameters defining the slope of inclusive spectra of cumulative π/sup -/-mesons (in contrast to cumulative protons) was similar for pC- and π/sup -/C-collisions.

46657 Spectroscopy of /sup 18/O: Radiative capture, / sup 14/C(α,γ)/sup 18/O. Gai, M.; Keddy, R.; Bromley, D.A.; Olness, J.W.; Warburton, E.K. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1256-1268(Oct 1987).

The electromagnetic deexcitation of the six known /sup 14/C+α resonances in the range E/sub α/ = 1.7—2.7 MeV was observed with a Ge(Li) detector. Results for the branching ratios of the 7.62-, 8.04-, and 8.13-MeV /sup 18/O levels were found to be in agreement with previous measurements. Deexcitation of the 7.86-, 8.21-, and 8.28-MeV levels was observed for the first time. The radiative widths of these three (α,γ) resonances were determined. Electromagnetic transition strengths were derived for all the resonances from the gamma-ray branching ratios and the total radiative widths. A selective and enhanced E1 decay (—10/sup -2/ W.u.) of the 3_3^- state is observed; among the available 2^+ states lower in excitation, this 3_3^- state is observed to deexcite only to the 2_3^+ state. The 2_3^+ state is well understood to involve excitations of the /sup 16/O core, whereas the 2_2^+ and 2_1^+ states arise mainly from simple two neutron (sd-shell) configurations. The relevance of the α+ / sup 14/C radiative capture reactions for nucleosynthesis of heavier elements, at the hadronization phase of the big bang, is discussed.

46658 Mass dependence of pion single-charge exchange to the isobaric analog state at 20 MeV. Irom, F.; Baer, H.W.; Bergmann, A.G.; Bowman, J.D.; Heusi, P.; Fitzgerald, D.H.; Seftor, C.J.; Sadler, M.E.; Knudson, J.N.; Briscoe, W.J.; and others. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1453-1458(Oct 1987).

Forward-angle differential cross sections for pion single-charge exchange to the isobaric-analog state were measured for ^{7}Li, /sup 14/C, /sup 15/N, and /sup 120/Sn at 20 MeV incident beam energy. Back-angle differential cross sections for ^{7}Li were also measured. The shape of the angular distributions for light nuclei is featureless. The cross section for ^{7}Li at 180° is as large as the cross section at 0°. The A dependence of the 0° cross section can be expressed as g(N-Z)A/sup α/ (with g = 534 and α = 0.73 +- 0.09), leading to the conclusion that the nuclear medium is neither strongly absorbing nor fully transparent. The data are compared with optical-model calculations.

46659 Ground-state photoneutron reactions in sup18O. Jury, J.W.; Kuo, P.C.; McNeill, K.G.; Ross, C.K.; Weller, H.R.; Raman, S. (Department of Physics, Trent University, Peterborough, Ontario, Canada K9J 7B8). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1243-1248(Oct 1987).

Differential cross sections have been measured for the reaction /sup 18/O(γ,n$_0$)/sup 17/O over the region of excitation energy from 14 to 26 MeV. The angle-integrated cross section for the ground-state transition reveals that this channel accounts for less than 20% of the total photoneutron cross section in the structured pygmy resonance region (near 14 MeV) and is a small fraction (10—15 %) of the cross section in the region of the giant resonance (near 25 MeV). The values of angular distribution coefficients fitted to the data are consistent with a description of this reaction in which electric dipole excitations dominate the cross section in the pygmy resonance. Narrow regions exist near 15.0, 16.0, and 20.0 MeV where nonzero a_1 coefficients are observed indicating the absorption of non-E1 radiation. The measured cross section and a_2 coefficients are compared to a direct-semidirect calculation which gives reasonable agreement and suggests that f-wave neutron emission dominates the ground-state channel and that there is little justification for the introduction of E2 amplitudes other than a pure direct E2 term.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

46660 (DOE/ER/03065—T6) Observation of antiproton annihilation in heavy nuclei at 100 GeV/c. Whitmore, J.; Lewis, R.A.; Oh, B.Y.; Smith, G.A.; Toothacker, W.S.; Neale, W.W.; Elcombe, P.A.; Hill, J.C,; Kowald, W.; Walker, W.D. (Pennsylvania State Univ., University Park (USA); Pennsylvania State Univ., Mont Alto (USA); Cambridge Univ. (UK). Cavendish Lab.; Duke Univ., Durham, NC (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Kansas Univ., Lawrence (USA)). 1987. Contract AS05-76ER03065. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014202.

We report on the observation of antiproton annihilation in Mg, Ag, and Au nuclei at 100 GeV/c. The experiment was performed with the Fermilab 30″ bubble chamber spectrometer and associated Downstream Particle Identifiers. By identifying events without a leading anti p or anti n we have determined that (39+-6)% of the antiprotons annihilate in a heavy nucleus. We present this fraction as a function of atomic mass number and discuss the associated charged particle multiplicity. 5 refs., 3 figs.

46661 Double charge exchange to the double isobaric analog state at T/sub π/—292 MeV. Zumbro, J.D.; Fortune, H.T.; Burlein, M.; Morris, C.L.; Wang, Z.; Gilman, R.; Dhuga, K.S.; Burleson, G.R.; Rawool, M.W.; Garnett, R.W.; and others. (University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1479-1483(Oct 1987).

Measurements of cross sections for the (π^+,π^-) reaction to the double isobaric analog state on targets of /sup 30/Si, /sup 34/S, /sup 44/Ca, /sup 50/Ti, /sup 51/V, /sup 52/Cr, and /sup 58/Ni at θ/sub lab/ = 5° and an incident pion kinetic energy of —292 MeV are presented. We also present limits for the cross section to the residual ground state for the four T>1 targets. The data are compared with a phenomenological two-amplitude model and with a two-amplitude model that uses seniority-zero shell-model wave functions. The latter model provides expressions for both ground state and double isobaric analog state cross sections.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

46662 (INIS-mf—10657) Quasi-elastic transfer and charge-exchange reactions in collisions of /sup 48/Ti on /sup 42/Ca and /sup 26/Mg. Brendel, C. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 5 - Physik). 16 Jul 1985. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE87752464.

At the GSI magnetic spectrometer quasi-elastic transfer and charge-exchange reactions of the system /sup 48/Ti + /sup 42/Ca at incident energies E/sub lab/ = 240, 300, and 385 MeV and additionally at the higher projectile energy the system /sup 48/Ti + /sup 26/Mg were studied each in the excitation energy range up to E/sub x/ ≃ 80 MeV. The transition strength was for each particle-hole configuration of the final system calculated by means of the DWBA and subsequently folded with a Breit-Wigner distribution. The localization of the strength of the cross section and the specific structure of the energy spectra were at incident energies between 6 and 8 MeV/amu for all angles well reproduced. By an extension of the core-excitation model to many-stage reactions the charge-exchange reaction /sup 48/Ti + /sup 42/Ca -> /sup 48/Sc + /sup 42/Sc could be described as sequential two-stage process. In the two-neutron stripping reaction /sup 48/Ti + /sup 42/Ca -> /sup 46/Ti + /sup 44/Ca a surprisingly narrow line with a width of the experimental resolution and an excitation energy of E/sub x/ = 17.8 MeV was measured at angles smaller than the grazing angle. In the /sup 48/Ti + /sup 26/Mg system the corresponding /sup 46/Ti spectra show also under forward angles structures at excitation energies between 8 and 16 MeV. These lines can be explained as two-neutron states with high spin. (orig./HSI).

46663 Elastic scattering of 30 MeV positive and negative pions from nickel isotopes. Wright, D.H.; Blecher, M.; Ritchie, B.G.; Boudrie, R.L.; Burman, R.L.; Leitch, M.J.; Alsolami, M.; Blanpied, G.S.; Escalante, J.A.; Mishra, C.S.; and others. (Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1472-1478(Oct 1987).

Elastic cross sections for the scattering of positive and negative pions from /sup 58,60,64/Ni were measured at 30 MeV incident pion energy. A clear isotope effect was observed in the π^- cross sections while no effect was observed in the π^+ cross sections. The cross sections were compared to predictions made by various optical model calculations. In general, both π^+ and π^- cross sections were poorly described and the π^- isotope effects were not well reproduced. Anomalous effects first observed in pionic atoms may also appear in the present data.

46664 Isospin structure of giant resonances from pion inelastic scattering. Seestrom-Morris, S.J. (University of Minnesota, Minneapolis, MN 55455). *AIP (American Institute of Physics) Conference Proceedings;* **142**: No. 1, 54-67(15 Jun 1986). (CONF-8510137—).

From International workshop on nuclear structure at high spin, high excitation, and high momentum transfer; Spencer, IN, USA (21 Oct 1985).

A large amount of data has been accumulated for the excitation of the giant quadrupole resonance by pion inelastic scattering. The π^+ and π^- cross sections measured for the self-conjugate nucleus /sup 40/Ca are equal, but for heavier nuclei with a neutron excess the π^- cross section is always larger than the π^+ cross section. Furthermore, the ratio $\sigma(\pi^-)/(\sigma(\pi^+)$ increases more rapidly than does N/Z for nuclei from /sup 90/Zr to /sup 238/U. The analysis of the existing data to extract neutron and proton matrix elements is discussed. Recent energy-dependence data for the GQR in /sup 208/Pb are used to draw some conclusions about the model dependence of the extracted strengths and the relative neutron and proton strengths.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

46665 (JINR—R-3-86-158) Measurement of /sup 67/Zn (n,α) /sup 64/Ni reaction thermal cross section and its interpretation in the framework of the Reich-Moore multilevel formalism. Vtyurin, V.A.; Zhak, A.; Popov, Yu.P.; Phuang Van Duan; Chadraabal, I.; Grebnev, A.V.; Kirilyuk, A.L.; Ukraintsev, V.F. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703116.

The cross section were measured of the /sup 67/Zn(n,α)/sup 64/Ni reaction on thermal neutrons. σ/sub α(sub 1)//sup th/ =130+40μb cross section of the α/sub 1/-transition into the first excited state of /sup 64/Ni has been obtained. The earlier observed suppression was confirmed of α/sub 0/-transition to the initial state on the level σ/sub α(sub 0)//sup th/ < 32 μb (in comparison with the calculated using the known parameters of resonances σ/sub α(sub 0)//sup th/=370 μb). This result is interpreted as an interference between the resonances. It is shown that, at a definite Γ/sub α(sub 0)/-width of the bound state with E/sub 0/=-337 eV, the experimental data for three and four levels could be described in the frame of the multilevel Reich-Moore formalism. Even though the probability of interference suppression is small, the above interpretation cannot be left aside. 14 refs.; 5 figs.; 4 tabs.

46666 Crystal blocking in heavy ion reactions. Gomez del Campo, J. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 447-453(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The crystal blocking technique for measuring short lifetimes (10^{-18} s) was developed during the 1960s from the study of the channeling effect. Early blocking lifetime measurements involved light ion resonance reactions yielding typical lifetime values of the order of 10^{-17} s. Recently, studies on heavy-ion induced fission and fusion have extended the technique into the 10^{-18} to 10^{-19} s scale. In this work measurements of fusion for ^{16}O+Ge are presented for bombarding energies around 8 MeV/nucleon. Also measurements of the projectile fragmentation of 44 MeV/ nucleon ^{40}Ar+Ge are discussed. In all reactions studied the presence of particle evaporation is the dominant mechanism that determines the reaction times of ≃ 10^{-18} s measured with the blocking technique.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

46667 (INIS-mf—10658) Study of the nuclear structure of /sup 128/Xe by means of the (α,n) reaction at threshold. Reinhardt, R. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 8 Feb 1986. 192p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87752468.

With the reaction /sup 125/Te(α,n)/sup 128/Xe near the Coulomb threshold 81 excited nuclear levels far from the Yrast line were populated. The determination of the level-specific quantities (J,π,E/sub Level/) was performed via following measuring methods: γ-excitation functions between 12.5 and 20 MeV beam energy; γ-angular distribution at 14.5 MeV α energy; γ-γ coincidence at

14.5 and 15.5 MeV projectile energy; conversion electron measurement at 16.5 MeV with transmission range between 400 und 1500 keV electron energy. 40 of the 81 populated states were not yet known. All levels hitherto only known from beta-decay data below 2.5 MeV were detected in the beam experiment. The ground-state band and the quasi-γ band could be populated up to the 10/sup +/ respectively 7/sup +/ and the level parameters verified. The non-selective character of the (α,n) reaction permitted to apply the direct population of a level (side feeding) to the spin determination. This was extensively discussed and an empirical fit formula given for the behaviour of the direct feeding as function of the beam energy, the level spin, and the level energy. In a comparison with the O(6) limit of the IBA-1 the collective states of the ground-state and the quasi-γ band were described. Furthermore the so-called tau=4 multiplet could be completely identified. (HSI).

46668 (KURRI-TR—277, pp 35-40) **Measurements on half-lives and absolute γ-ray emission probabilities of thermal-neutron induced fission-product nuclei.** Okano, Kotoyuki; Kawase, Yoichi; Funakoshi, Yoshihiro. (Kyoto Univ., Kumatori, Osaka, Japan. Research Reactor Inst.). Apr 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780156. (CONF-8602137—).

From 2. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (4 Feb 1986).

Pn value is one of the important microscopic nuclear constants which are related to delayed neutrons governing the dynamic characteristics of a nuclear power reactor. Though a large number of measurements have been reported in many publications, there are large differences among them. Pn values can be calculated based on accurate nuclear data on the β decay process of related nuclides. Basic nuclear data required include those on the absolute emission probability per decay (Pa value) of the principal γ-ray as well as on the half life. In the present study, an apparatus is developed which uses an ISOL (isotope separator on line) system for half-life measurement. A large type Ge(Li) detector is employed, and correction is made for the count loss due to the dead time of the pulse height analyzer and the pile up of pulses. Half-life measurement is carried out for various nuclides. In particular, there have been no or few reports to date on /sup 155/Nd, /sup 156/Pm, /sup 153/Nd, /sup 154/Nd and /sup 155/Pm. For other nuclides, the measurements made are in the neighborhood of the average of those reported previously. In addition, γ-ray emission probability (Pa) measurements are made for /sup 95/Rb, /sup 95/Sr and /sup 95/Y. Since only Rb is ionized in the ISOL system used here, the so-called filiation method is applied to the decay series /sup 95/Rb -> /sup 95/Sr -> /sup 95/Y -> /sup 95/Zr -> /sup 95/Mo. The systematics of logf/sub 1/t for the ground-ground first unique β-transition of /sup 91/Y, /sup 93/Y and /sup 95/Y shows good agreement with theoretical predictions. (Nogami, K.).

46669 **Absolute photoneutron cross sections for Zr, I, Pr, Au, and Pb.** Berman, B.L.; Pywell, R.E.; Dietrich, S.S.; Thompson, M.N.; McNeill, K.G.; Jury, J.W. (Department of Physics, The George Washington University, Washington, D.C. 20052). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 4, 1286-1292(Oct 1987).

The photoneutron cross sections for /sup nat/Zr, /sup 127/I, /sup 141/Pr, /sup 197/Au, and /sup nat/Pb have been measured near the peak of the giant dipole resonance, with monoenergetic photons, in such a way that the absolute cross sections for these nuclei were intercalibrated, using /sup 141/Pr as a benchmark. The measured peak total photoneutron cross sections are, within an uncertainty of 2—3 %, 174, 252, 340, 502, and 602 mb for /sup nat/Zr, /sup 127/I, /sup 141/Pr, /sup 197/Au, and /sup nat/Pb, respectively. These results resolve outstanding discrepancies among previous measurements.

46670 **Transition through triaxial shapes of the light samarium isotopes and the beta decay of /sup 136,138,140/Eu.** Kern, B.D.; Mlekodaj, R.L.; Leander, G.A.; Kortelahti, M.O.; Zganjar, E.F.; Braga, R.A.; Fink, R.W.; Perez, C.P.; Nazarewicz, W.; Semmes, P.B.; and others. (University of Kentucky, Lexington, Kentucky 40506). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 4, 1514-1521(Oct 1987).

Levels in /sup 136,138,140/Sm were populated by the beta decay of Eu, following (HI,pxn) reactions and on-line mass separation. The beta decay of /sup 136/Eu with a half-life of 3.9(+- 0.5) s was observed for the first time. Members of the γ band were observed in all three daughter nuclei. Spectroscopic calculations were made using the triaxial rotor model, with all parameters derived microscopically from a Woods-Saxon deformed shell model. Other spectroscopic models were also considered. Comparison with the data supports the characterization of these nuclei in terms of a triaxial intrinsic shape.

46671 **Beta-decay of light rare-earth /sup 130,132/Pr and /sup 132,134/Pm nuclei.** Kortelahti, M.; Zganjar, E.F.; Mlekodaj, R.L.; Kern, B.D.; Braga, R.A.; Fink, R.W.; Perez, C.P. (Louisiana State Univ., Baton Rouge, USA. Dept. of Physics; Oak Ridge Associated Universities, Inc., TN, USA; UNISOR, Oak Ridge, TN, USA; Kentucky Univ., Lexington, USA. Dept. of Physics and Astronomy; Georgia Inst. of Tech., Atlanta, USA. School of Chemistry). *Zeitschrift fuer Physik A: Atomic Nuclei;* **327**: No. 2, 231-232(Jun 1987). Contract FG05-84ER40159;AC05-76OR00033;AS05-76ER03346.

Gamma-ray spectra of neutron-deficient isotopes of /sup 130,132/Ce and /sup 132,134/Nd have been investigated from the β-decay of /sup 130,132/Pr and /sup 132,134/Pm. New gamma-bands of states were identified and the systematic trends are presented.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

46672 **(UCRL—95543) Special targets for nuclear reaction and spectroscopic studies.** Lanier, R.G. (Lawrence Livermore National Lab., CA (USA)). 31 Jul 1987. Contract W-7405-ENG-48. 8p. (CONF-8709118—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014229.

From American Chemical Society symposium series 324; Chicago, IL, USA (8 Sep 1987).

Strongly focused and monoenergetic charged-particle beams from modern accelerators and targets fabricated from quantities of isotopically enriched and stable materials are the essential components from many current nuclear physics experiments. Although a large body of this kind of experimental work requires substantial amounts of target material, an important subset of such experiments can be done with as little as a few μg of material. Experiments where charged particles or electrons can be focused on or transported to a detector are examples of accelerator-based studies which can be made with targets that contain relatively small amounts of material. For these kinds of studies, it then becomes possible to extend the domain of potential target materials to species which are very rare or which are unstable and undergo radioactive decay. At our laboratory during the last ten years, we have made targets for nuclear spectroscopy studies of ^{152}Eu (13.4y), ^{154}Eu (8.5y), ^{249}Bk (320d), ^{151}Sm (90y), and ^{148}Gd (75y). We will report our experience with fabricating these and other kinds of stable targets and discuss our plans for preparing additional targets which offer interesting and exciting prospects for future nuclear research studies. 12 refs., 1 fig., 2 tabs.

46673 **Level structure of /sup 159/Eu from the βp decay of the recently discovered isotope /sup 159/Sm.** Willmes, H.; Anderl, R.A.; Cole, J.D.; Greenwood, R.C.; Reich, C.W. (Department of Physics, University of Idaho, Moscow, Idaho 83843). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 4, 1540-1545(Oct 1987).

An on-line isotope-separator facility has been used to determine the energies and intensities of sixteen γ rays following the β^- decay of the recently discovered isotope /sup 159/Sm. From these data, the existence of a new level in /sup 159/Eu at 1051.80 keV has been established, and tentatively assigned as the (7/2$^-$[523] bandhead. The /sup 159/Sm ground state is tentatively assigned as the (5/2$^-$[523] Nilsson state. Some of the deduced features of the reduced γ-ray transition probabilities as they relate to the proposed rotational-band structure in /sup 159/Eu are briefly discussed.

46674 Distribution of reaction strength in /sup 32/S+/ sup 182/W collisions. Keller, J.G.; Back, B.B.; Glagola, B.G.; Henderson, D.; Kaufman, S.B.; Sanders, S.J.; Siemssen, R.H.; Videbaek, F.; Wilkins, B.D.; Worsham, A.; and others. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 4, 1364-1374(Oct 1987). Contract W-31-109-ENG-38.

The reaction /sup 32/S+ /sup 182/W has been studied at beam energies of 166, 177, 222, and 260 MeV with the goal of accounting for the distribution of the total reaction cross section among the main reaction channels. Cross sections as well as mass and energy distributions were measured over the entire angular range from 10° to 170° for elastic (which includes quasi-elastic), deep-inelastic, and fission-like products. Deep inelastic scattering accounts for a substantial fraction of the total reaction cross section at all energies, in particular near the barrier. This behavior is not predicted by current theories such as the extra push model. The angular distributions of fission-like products are more anisotropic than expected on the basis of the saddle point model at the two lowest energies, indicating a sizable contribution from quasi-fission processes, which is estimated from a quantitative analysis of this deviation.

46675 Quantum interference measurement using microfoil conversion electron (MICE) detection. Mullen, J.G.; Djedid, A.; Yelon, W.B.; Schupp, G.; Crow, M.L. (Purdue Univ., Lafayette, IN). *Applied Physics Communications;* **7**: No. 1-2, 119-120(Mar-Jun 1987). Contract FG02-85ER45199;FG02-85ER45200.

By using a MICE detector and a new technique for representing convolution integrals, they have been able to make precision measurements of the interference parameter and isomer lifetime for the 46.5 keV gamma transition in ^{183}W. Because the signal-to-background obtained by this technique is a factor of 20 greater than for conventional transmission Moessbauer spectroscopy, the present results indicate that a new level of accuracy in time reversal invariance studies using the Moessbauer approach may be possible, giving a critical test of some of the theories of T breakdown involving possible fifth forces in nature. The measured interference parameter is in very good agreement with theory.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

46676 (GSI—87-25-Prepr.) Collectivity in composite fragment emission from relativistic heavy ion collisions. Bock, R.; Claesson, G.; Gutbrod, H.H.; Kolb, B.; Schmidt, H.R.; Doss, K.G.R.; Harris, J.W.; Kristiansson, P.; Lefebres, F.; Poskanzer, A.M. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA); Oak Ridge National Lab., TN (USA); Los Alamos National Lab., NM (USA); Lund Univ. (Sweden); Muenster Univ. (Germany, F.R.)). May 1987. 10p. NTIS, PC E07; Available from NTIS as TIB/B87-10824.

Composite fragments of $2<Z<10$ have been measured in the Plastic Ball Spectrometer in 200 MeV/nucleon Au+Au and Au+Fe collisions. Strong azimuthal alignment of the fragments reveal the collective behaviour of the reaction.

46677 Energy dependence of the optical-model potential for fast-neutron scattering from bismuth. Lawson, R.D.; Guenther, P.T.; Smith, A.B. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 4, 1298-1311(Oct 1987). Contract W-31-109-ENG-38.

Neutron differential-elastic-scattering cross sections of bismuth were measured at ≅0.5 MeV intervals from ≅4.5 to 10.0 MeV. At each incident energy 40 or more differential values were obtained between ≅18° and 160°. These data were combined with lower-energy results previously reported from this laboratory, and others available in the literature, to provide a detailed data base extending from ≅1.5 to 10.0 MeV. This data base was interpreted in terms of the conventional optical-statistical model and also using a model which included the surface-peaked real potential predicted by the dispersion relation. Particular attention was given to the energy dependence of the volume-integral-per-nucleon of the real potential, J/sub v/, to see if there was evidence of the Fermi surface anomaly. In the range 3.0—10.0 MeV, the present study indicates that dJ/sub v//dE is essentially constant, with a relatively large negative value of -6.0 to -9.0 fm^3, depending on the model used in the analysis. Below 3.0 MeV, there is some evidence for a decrease in the magnitude of dJ/sub v//dE. However, the effect is very small, and it is only when this trend is combined with considerations of the J/sub v/ values needed to give correct bound-state energies that evidence for the Fermi surface anomaly emerges. J/sub v/ and the geometry of the optical potentials found for /sup 209/Bi become equal to those explaining the higher-energy /sup 208/Pb data at about 10.0 MeV.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

46678 (NEANDC(E)—282-U-Vol.3-EURATOM) Annual progress report on nuclear data, 1986. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Jun 1987. 69p. (INDC(EUR)—021/G). NTIS (US Sales Only), PC A04/MF A01. File Number DE87900963.

In the reporting period 1986 efforts for the improvement of the set of standard neutron cross-sections and other quantities selected within the INDC/NEANDC Standards File have continued. In the field of nuclear data for fission technology work was concentrated on European Requests in the NEA High Priority Request List. The measurements for fusion technology aimed at the improvement of relevant and important neutron data in particular for neutron transport calculations in the blanket which contains lithium as a tritium breeder material and for prediction of gas production. The radionuclide task followed three lines: determination of decay-scheme data, preparation of special standards and the improvement of measurement techniques including international comparisons. In the field of metrology of neutron flux and dose the Central Bureau for Nuclear Measurements participated in international comparisons of neutron fluence rates (1) at 565 keV, organized by NPL, Teddington and (2) at several energies via fission fragment counting with ionization chambers, organized by AERE, Harwell. The characteristic parameters of the CBNM graphite calorimeter were determined experimentally and the tissue-equivalent plastic (TEP) calorimeter was put into operation. 36 figs., 5 tabs.

46679 (UCRL—95966) Dipole strength functions in the actinide mass region. Gardner, D.G.; Gardner, M.A.; Hoff, R.W. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 4p. (CONF-8708101—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014341.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

We have calculated a number of neutron- and photon-induced reactions for the actinide nuclei ^{232}Th, ^{238}U, and ^{237}Np. By fitting average resonance capture (ARC) measurements and total neutron capture data, we deduced absolute dipole strength functions for ^{233}Th and ^{239}U. We have found that the M1/E1 ratio is the same as in the ^{176}Lu case, but the total transition strength was larger by about 27%. 17 refs., 4 figs., 1 tab.

46680 (UCRL—97089) Evidence for bimodal fission in the heaviest elements. Hulet, E.K.; Wild, J.F.; Lougheed, R.W.; Dougan, R.J.; Landrum, J.H.; Dougan, A.D.; Schaedel, M.; Hahn, R.L.; Baisden, P.A.; Henderson, C.M. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 12p. (CONF-870970—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014553.

From 5. international conference on nuclei far from stability; Lake Rosseau, Canada (14 Sep 1987).

We have measured the mass and kinetic-energy partitioning in the spontaneous fission of five heavy nuclides: ^{258}Fm, ^{259}Md, ^{260}Md ^{258}No, and ^{260}[104]. Each was produced by heavy-ion reactions with either ^{248}Cm, ^{249}Bk, or ^{254}Es targets. Energies of correlated fragments from the isotopes with millisecond half lives, ^{258}No and ^{260}[104], were measured on-line by a special rotating-wheel in-

strument, while the others were determined off-line after mass separation. All fissioned with mass distributions that were symmetric. Total-kinetic-energy distributions peaked near either 200 or 235 MeV. Surprisingly, because only a single Gaussian energy distribution had been observed previously in actinide fission, these energy distributions were skewed upward or downward from the peak in each case, except for ^{260}[104], indicating a composite of two energy distributions. We were able to fit accurately two Gaussian curves to the gross energy distributions from the four remaining nuclides. From the multiple TKE distributions and the shapes of the mass distributions, we conclude that there is a low-energy fission component with liquid-drop characteristics which is admixed with a much higher-energy component due to closed fragment shells. We now have further evidence for this conclusion from measurements of the neutron multiplicity in the spontaneous fission of ^{260}Md. 25 refs., 9 figs.

46681 Analysis of fissionable material using delayed gamma rays from photofission. Hollas, C.L.; Close, D.A.; Moss, C.E. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **24/25**: No. 1, 503-505(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Also published as report LA-UR—86-3363; CONF-861114—14–2.

The energetic gamma-ray spectra from the fission products of photofission have been investigated to determine whether photofission can identify heavily shielded fissionable material. Target samples of natural thorium, 93% enriched ^{235}U, natural uranium, and 93% enriched ^{239}Pu were irradiated with bremsstrahlung gamma rays produced by 10-MeV electrons from a small linear accelerator. The gamma-ray spectra for each of the four isotopes studied reveal a distinctive intensity distribution. For example, the intensity ratio of the pair of gamma rays at 1436 keV (^{138}Cs) and 1428 keV (^{94}Sr) is 1.9 for ^{235}U, 2.4 for ^{238}U, 1.7 for ^{232}Th and 1.4 for ^{239}Pu.

46682 Analysis of fissionable material using delayed gamma rays from photofission. Hollas, C.L.; Close, D.A.; Moss, C.E. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 503-505(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

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6530 Nuclear Theory

REFER ALSO TO CITATION(S) 46475, 46641, 46643, 46644, 46645, 46647, 46670

46683 (BNL—40142) The proton-neutron interaction and nuclear collectivity. Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 15p. (CONF-8708101—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014393.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

A review is given of several aspects, and empirical consequences, of the p-n interaction as it relates to the structure, phase transitions and collectivity of medium and heavy nuclei. The N/sub p/N/sub n/ scheme is reviewed as background material while the emphasis centers on a discussion of a related quantity, the P factor, and on the relationship of the integrated strength of the p-n interaction to the empirically observed "saturation" of B(E2) values in the mid-shell regions of deformed nuclei. 19 refs., 13 figs.

46684 (BNL—40149) A study of the structure of ^{163}Dy through the (n,γ) and (n,e$^-$) reactions. Warner, D.D.; Shi, Z.R.; Gelletly, W.; Borner, H.G.; Hoyler, F.; Schreckenbach, K.; van Isacker, P. (Brookhaven National Lab., Upton, NY (USA); Daresbury Lab. (UK); Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy; Manchester Univ. (UK). Schuster Lab.; Institut Laue-Langevin, 38 - Grenoble (France); Sussex Univ., Brighton (UK). School of Mathematics and Physics). 1987. Contract AC02-76CH00016. 4p. (CONF-8708101—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014391.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

The level structure below 2 MeV in ^{163}Dy has been investigated using the ^{161}Dy(n,γ)^{163}Dy and ^{161}Dy(n,e$^-$)^{163}Dy reactions. The results for the positive parity excitations are discussed within the framework of an Interacting Boson Approximation (IBA-2) calculation. 7 refs., 1 fig., 1 tab.

46685 (BNL—40150) M1 transitions between collective levels and F-spin purity. von Brentano, P.; Frank, W.; Gelberg, A.; Harter, H.; Krips, W.; Casten, R.F.; Boerner, H.G.; Krusche, B. (Brookhaven National Lab., Upton, NY (USA); Koeln Univ. (Germany, F.R.). Inst. fuer Kernphysik; Institut Laue-Langevin, 38 - Grenoble (France)). 1987. Contract AC02-76CH00016. 9p. (CONF-8708101—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014390.

From 6. international symposium on capture gamma-ray spectroscopy; Leuven, Belgium (31 Aug 1987).

M1 transitions between low-lying collective levels in deformed nuclei are described within the IBM-2 framework. This is done by a special choice of the Hamiltonian which allows a simultaneous fit of energies, E2 and M1 transitions. Finally, the results are interpreted using the F-spin concept. 12 refs., 4 tabs.

46686 (CONF-8708102—2) Pion charge exchange and nuclear structure: II, Nuclear structure calculation. Bartel, J.; Johnson, M.B.; Singham, M. (Los Alamos National Lab., NM (USA); Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1987. Contract AC02-76ER02171. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014042.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Whereas the nuclear charge distribution, essentially determined by the protons, has been studied for decades in elastic electron scattering, a study of the neutron distribution in nuclei has only recently become possible through pion charge-exchange experiments. The excitation of the isobaric analog state (IAS) in pion single-charge-exchange reactions is one of the most prominent candidates for such an investigation which will be especially interesting for strongly deformed nuclei which can be aligned in magnetic fields. This contribution concentrates on calculations related to such a reaction for the rare-earth nucleus Ho-165. 8 refs., 3 figs.

46687 (GSI—87-24-Prepr.) New developments in nuclear fission. Hasse, R.W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1987. 16p. (CONF-8706182—2-Prepr.). NTIS, PC E07; Available from NTIS as TIB/B87-10823.

From All-Union symposium on physics of nuclear fission; Obninsk, USSR (2 Jun 1987).

A few recently observed new effects in nuclear fission are reviewed from the experimental side and theoretical explanations are indicated: (i) The structures in the mass yields and in the maximum fragment kinetic energies in cold fission are due to Coulomb effects; (ii) Mass-symmetric fission of even-even nuclei does not proceed by splitting the nucleus into two equal parts and the fragments are differently deformed; (iii) The dip in the total fragment

kinetic energy at symmetry is due to a different symmetric fission barrier; (iv) In analogy to the cold compact fission events with highest kinetic energy, also those events of lowest kinetic energy but highest deformation are cold at the scission point; (v) Cold fission proceeds close to the saddle point.

46688 **(IC—86/276) Quark cluster model in the three-nucleon system.** Osman, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703055.

The quark cluster model is used to investigate the structure of the three-nucleon systems. The nucleon-nucleon interaction is proposed considering the colour-nucleon clusters and incorporating the quark degrees of freedom. The quark-quark potential in the quark compound bag model agrees with the central force potentials. The confinement potential reduces the short-range repulsion. The colour van der Waals force is determined. Then, the probability of quark clusters in the three-nucleon bound state systems are numerically calculated using realistic nuclear wave functions. The results of the present calculations show that quarks cluster themselves in three-quark systems building the quark cluster model for the trinucleon system. 33 refs, 2 figs.

46689 **(IC—86/300) Total disintegration of three-nucleon systems from charged π-mesons reactions.** Osman, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703060.

The nuclear reactions of incident charged π-mesons on three-nucleon system targets are considered. The double charge exchange process is considered for these reactions. The double-charge exchange reactions of charged π/sup +/ and π/sup -/ mesons on the /sup 3/H and /sup 3/He nuclei proceed through the only channel of total disintegration of these nuclei, leading to the final states of free three protons or three neutrons, respectively. The same Hamiltonian and the same nucleon-nucleon interaction are used in representing the initial and final nuclear states. The Faddeev formalism is used in describing the three nucleons. Numerical calculations are carried out for the differential and total cross sections using different nucleon-nucleon potentials. The present theoretical calculations are in good agreement with the experimental data. 18 refs, 6 figs.

46690 **(KFKI—1986-80/A) Thermodynamical considerations for the rehadronization of a quark-gluon plasma.** Lukacs, B.; Zimanyi, J.; Balazs, N.L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Oct 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703119.

The thermodynamics of a quark plasma in equilibrium with a hadronic phase assuming strangeness conservation was studied. It is stated that the presence of strangeness conservation does not lead to a discontinuity in the chemical potential μ/sub s/ associated with the strange particles but to a coexistence region in the phase diagram. The discontinuity computed earlier is in fact the difference in the values of μ/sub s/ at the boundaries of the coexistence region keeping T fixed. 5 refs.

46691 (KURRI-TR—277, pp 41-47) **Mass formulas and β-decay theory of short-lived nuclei.** Yamada, Masami. (Waseda Univ., Tokyo, Japan. Science and Engineering Research Lab.). Apr 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780156. (CONF-8602137—).

From 2. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (4 Feb 1986).

The mass and β-decay represent important aspects of nuclei in an unstable state. The present report deals with theories for them. To analyze mass data, some terms have been proposed in addition to those involved in the Weizsacker-Bethe formula. Review is first made of such terms. There must be unknown higher-order terms and it should be noted that the introduction of a higher-order term would greatly affect the coefficients of low-order terms. The report then addresses shell terms, citing experimental results. A few characteristic phenomena including the mutual support of magicities are also described. Masses predicted by extrapolation of mass formulas are compared with experimental data, showing that existing formulas cannot give satisfactory values. Next, consideration is made on β-strength functions, and three types of theories for β-strength functions are reviewed. The final part of the report deals with the attempt to improve theories on the mass and β-decay conducted by the present author. Taking into account the mutual support of magicities, a term representing the interaction between a proton and neutron is introduced into a mass formula which has previously been proposed by the author. Considerations are made for the charge symmetry. For β-decay, an effort is currently made to improve the Gamow-Teller single-particle strength function. A few examples of improvements made on the function are presented and discussed. (Nogami, K.).

46692 **(RCNP-P—80) Report of fission study meeting.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Mar 1986. 148p. (In Japanese). (CONF-8509407—Summ.). NTIS (US Sales Only), PC A07/MF A01. File Number DE87703016.

From Fission study meeting; Ibaraki, Japan (19 Sep 1985).

This book is the report of fission study meeting held from September 19 to 21, 1985 in the Research Center for Nuclear Physics, Osaka University. The objective of this study meeting was to stimulate the research on nuclear physics in Japan, which began to show new development accompanying the advance of the research on heavy ion nuclear reaction, and to make this a new starting point. More than 50 participants from physical, chemical and engineering fields, who have interest in the theory and experiment related to nuclear fission, gathered, and the meeting was a success beyond expectation. The contents covered a wide range including nuclear smashing reaction as well as nuclear fission in a narrow sense. In this book, the gists of 28 papers are collected. (Kako, I.).

46693 **(RCNP-P—83) Report of seminar on relativistic approach to nuclear reaction and nuclear structure.** (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). May 1986. 196p. (In Japanese). (CONF-8511307—Summ.). NTIS (US Sales Only), PC A09/MF A01. File Number DE87703019.

From Seminar on relativistic approach to nuclear reaction and nuclear structure; Osaka, Japan (28 Nov 1985).

A seminar on 'Relativistic Approach to Nuclear Reaction and Nuclear Structure' was held in 1985 at Osaka University. This booklet includes twenty-four reports given at the seminar, which deal with: Conventional Nonrelativistic Description of Nuclear Matter and Nuclear Spin-Orbit Interactions; Relativistic Approach to Nuclear Structure; Atomic and Molecular Structure Calculations; Electromagnetic Interaction in Nucleus and Relativistic Effect; Nuclear Magnetic Moment in the Relativistic Mean Field Theory, Effective Mass and Particle-Vibration Coupling in the Relativistic σ-ω Model; Gauge Invariance in Relativistic Many-Body Theory; Relativistic Description of Nucleon-Nucleon Interaction in Review; σ-Particle in NN Interaction; Nuclear Optical Potentials Based on the Brueckner-Hartree-Fock Approach; Elastic Backscattering and Optical Potential; Description of Intermediate-Energy Nuclear Reactions; Dirac Phenomenology at E(p) = 65 MeV; Relativistic Impulse Approximation; Reaction Studies with Intermediate Energy Deuterons at SATURNE; Folding Model for Intermediate-Energy Deutron Scattering; Folding Model for Polarized Deutron Scattering at 700 MeV; Dirac Approach Problems and a Different Viewpoint; Relativistic Approach and EMC Effect; Quasielastic Electron Scattering; Response Function of Quasielastic Electron Scattering; Relativistic Hartree Response Function for Quasielastic Electron Scattering on /sup 12/C and /sup 40/Ca; Backflow-, Retardation- and Relativistic Effects on the Longitudinal Response Function of Nuclear Matter; Pion-Photoproduction in the σ-ω Model. (Nogami, K.).

46694 **(UCRL—97262) Heavy ion precompound phenomena: A glance at hard gamma and subthreshold pion production.** Blann, M.; Remington, B.A. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 22p. (CONF-8706113—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014353.

From 6. Adriatic international conference on nuclear physics; Dubrovnik, Yugoslavia (15 Jun 1987).

We test a relaxation model based on two body nucleon-nucleon scattering processes to interpret phenomena observed in heavy ion reactions. We use the Boltzmann master equation to accomplish this. By assuming that the projectile nucleons share the total excitation with equal a-priori probability of all configurations, we are able to reproduce several sets of neutron spectra from ^{20}Ne and ^{12}C induced reactions on ^{165}Ho. With no additional free parameters our model successfully reproduces subthreshold pion production cross sections, high energy γ-ray spectra, and angular distributions of high energy γ-rays. 40 refs., 12 figs., 2 tabs.

46695 **Unitary meson-exchange πNN models: NN and πd elastic scattering.** Lee, T.H.; Matsuyama, A. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1459-1471(Oct 1987). Contract W-31-109-ENG-38.

Within a unitary πNN theory a set of coupled integral equations defined in the NNdirect-sumNΔ direct-sumπNN subspace has been derived for examining the extent to which the NN and πd elastic scattering data can be both described by a class of meson-exchange πNN models. The considered models are constructued by using a previously developed subtraction procedure to extend the Paris, Bonn, Argonne-V14, and Reid NN potentials to include the coupling to the πNN production channel. The pion production through the Δ excitation is described by a πNbold-arrow-left-rightΔ vertex and a V/sub NN//sub bold-arrow-left-right//sub N//sub Δ/ transition potential, while the production through non-resonant πN interactions is described by a transition operator F/sub π//sub NN//sub bold-arrow-left-right//sub NN/. It is found that none of the constructed models can accurately reproduce all NN and πd elastic scattering data, in particularly the data of polarization observables. Our results indicate that either the conventional phenomenological parametrizations of baryon-baryon interaction at short distances are not valid in the intermediate energy region, or some genuine quark dynamics has already been revealed in the πNN data.

46696 **Bound-state beta decay of highly ionized atoms.** Takahashi, K.; Boyd, R.N.; Mathews, G.J.; Yokoi, K. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1522-1528(Oct 1987).

Nuclear β decays of highly ionized atoms under laboratory conditions are studied. Theoretical predictions of β-decay rates are given for a few cases in which bound-state β decay produces particularly interesting effects. A possible storage-ring experiment is proposed for measuring bound-state β-decay rates, which will be most easily applied to the decay of $^{3}H^{+}$. .AE

46697 **Comment on "Electroexcitation of M4 transitions in /sup 17/O and /sup 18/O".** Millener, D.J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1643-1645(Oct 1987). Contract AC02-76CH00016.

It is shown that the energies and strengths of states at high excitation energy in /sup 17/O which are strongly excited at high q by inelastic electron scattering may be understood in terms of p/sub 3/2//sup -1/ x d/sub 5/2/ weak-coupling configurations, and that the spin assignments suggested by Manley et al. are unlikely to be correct. Also, it is pointed out that a problem can arise in the interpretation of observed M4-like strength since M4 and E3 form factors from the magnetization current are known to be identical in shape for 0p→0d transitions (in addition, M2 and E1 form factors can also peak at high q). Comments are also made on states observed in /sup 18/O.

46698 **Spectral distribution calculations of the level density of /sup 24/Mg.** Strohmaier, B.; Grimes, S.M.; Satyanarayana, H. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1604-1610(Oct 1987).

Spectral distribution calculations of the level density of /sup 24/Mg are compared with experimental values for the level density of this nucleus as well as with Fermi gas calculations. Particular attention is paid to the technique used for the expansion. Traditional techniques which have utilized knowledge of the third and fourth moments of the Hamiltonian have yielded a distribution function that is not positive definite. Two alternative expansion methods are examined. One is found to be unacceptable because of the fact it does not yield a unique fit, but the second appears to be quite useful. Not only is the resultant expansion positive definite, but it appears capable in principle of giving a more detailed representation of the level density than the traditional method. Results of the calculation for two different basis sizes are compared.

46699 **Nuclear bound states of the eta^{0} meson and pion double-charge-exchange reactions.** Haider, Q.; Liu, L.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 4, 1636-1639(Oct 1987).

We predict a narrow resonance structure (Γ≅10 MeV) in the excitaton function of (π^{+},π^{-}) double-charge-exchange reactions at a pion kinetic energy of —419 MeV. This structure is due to the interference between the usual $\pi^{+}\rightarrow\pi^{0}\rightarrow\pi^{-}$ double-charge-exchange amplitudes, which have a smooth energy dependence, and a resonant $\pi^{+}\rightarrow eta^{0}\rightarrow\pi^{-}$ high-energy double-charge-exchange amplitude associated with the formation of a strongly bound eta-nucleus system. The latter process leads to a novel feature of the pion-nucleus interaction, the mesonic compound nucleus resonance.

46700 **Algorithm for integrating the Schroedinger equation.** Thorlacius, A.E.; Cooper, E.D. (TRIUMF, 4004 Wesbrook Mall, Vancouver, British Columbia, Canada V6T 2A3). *Journal of Computational Physics;* **72**: No. 1, 70-77(Sep 1987).

Presented here is an algorithm tailored to solve the radial Schroedinger equation for the case of proton scattering from an optical potential. The algorithm is straightforward to use and results in a significant increase in speed, around a factor of 2 at least, over the conventional Numerov algorithm. Copyright 1987 Academic Press, Inc.

46701 **Report on the parallel session on high energy nuclear interactions.** Mc Lerran, L. (Fermi National Lab., P.O. Box 500, Batavia, IL 60510). pp 209-229 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The possibility that high energy nuclear collisions may give some new insight into the dynamics of QCD is discussed. Recent experimental data on the EMC is discussed in the perspective of various theoretical models for the effect. The prospects of making and observing a quark-gluon plasma in ultra-relativistic nuclear collisions is reviewed. The status of experimental programs at CERN and at BNL is assessed.

46702 **REview of double beta decay experiments.** Caldwell, D.O. (Physics Dept., Univ. of California, Santa Barbara, CA 93106). pp 951-959 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The search for neutrinoless double beta decay is seeking the physics beyond the standard model. While there is as yet no evidence for a positive effect, the lifetime limit (now 4.7x10/sup 23/ yrs) provides important constraints on theories in the form of the best limits on, lepton number nonconservation, the effective mass of a light Majorana electron neutrino, the existence of right-handed currents for the conditions in which the "see-saw" mechanism provides neutrino mass, the mass of a heavy Majorana neutrino as a function of its coupling to the electron neutrino, the coupling of a Majoron to the electron neutrino, and the μ/sup —/ squark mass as a function of gaugino mass. Experiments are taking data in 7 countries, and in addition progress is being made on two-neutrino double beta decay, which is important for deducing the interesting physics parameters from the neutrinoless decay. Current limits and their interpretation are presented below.

46703 **Theory of double beta decay.** Vogel, P. (Physics Dept., California Institute of Technology, Pasadena, CA 91125). pp 942-944 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The nuclear matrix elements for 2ν double beta decay is calculated. It is shown that the decay matrix element passes through zero as a function of the coupling constant, g/sup pp/, of the particle-particle component of the spin-isospin polarization force, neglected previously. The analysis of EC/β/sup +/ decay rates for semi-magic nuclei suggests values for g/sup pp/ in the very vicinity of this zero, thereby yielding long lifetimes and providing a possible resolution of the longstanding discrepancy between calculated and measured 2ν double beta decay rates.

46704 **Relativistic effects in nuclear physics.** Brown, G.E. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *AIP (American Institute of Physics) Conference Proceedings;* **142**: No. 1, 2-26(15 Jun 1986). (CONF-8510137—).

From International workshop on nuclear structure at high spin, high excitation, and high momentum transfer; Spencer, IN, USA (21 Oct 1985).

Relativistic corrections to the nonrelativistic nuclear many-body problem are treated in perturbation theory, beginning from a zero-order wave function in which nucleons are in positive energy states in a plane-wave representation. Corrections arise from virtual pairs. Two important relativistic effects arise: (1) A repulsive term in the energy per particle (δepsilon-c-bar)/sub rel/ = 2.4(/sub rho//rho$_0$)/sup 8/3/ MeV, where rho$_0$ is nuclear matter density, comes from the virtual pair terms. This term can equivalently be viewed as coming from a density-dependent correction to the mass of the exchanged scalar boson. (2) The nucleon-nucleon spin-orbit interaction is modified. Effectively, the nucleon mass which enters into this interaction is changed locally by scalar fields which connect to virtual pair states.

46705 **Effects of meson exchange currents, unbound wave functions, and knockout exchange amplitudes on the extraction of particle-hole strengths for 1h-dash-barω stretched states.** Lindgren, R.A.; Leuschner, M.; Clausen, B.L.; Peterson, R.J.; Plum, M.A.; Petrovich, F. (University of Virginia, Charlottesville, VA 22901). *AIP (American Institute of Physics) Conference Proceedings;* **142**: No. 1, 133-154(15 Jun 1986). (CONF-8510137—).

From International workshop on nuclear structure at high spin, high excitation, and high momentum transfer; Spencer, IN, USA (21 Oct 1985).

It is well known that the strength for excitations of 1h-dash-barω high spin, stretched states observed via inelastic scattering is generally much smaller than that predicted by spherical shell model calculations. In addition, results obtained from electromagnetic and hadronic studies have discrepancies at the 20% level. To gain a better understanding of reduced magnetic strength in electron scattering and hopefully close the gap between experiment and theory, calculations of the electron scattering form factors have been performed including the effects due to meson exchange currents in the transition amplitude and the effects due to unbound wave functions for the valence nucleon. The effect of the meson exchange current contributions is to uniformly enhance the form factors near the first maximum resulting in a 16 to 20% further reduction of the stretched particle-hole strength. The effect due to the radial wave functions deduced from Woods-Saxon potentials in which the nucleon is not bound is to reduce the form factors, thereby resulting in an increase in the spectroscopic strength. In regard to the comparison of results obtained with electromagnetic and hadronic probes, the implied sensitivity to higher order current and spin-current transition densities associated with the non-locality due to the tensor knockout exchange amplitudes in nucleon-nucleus scattering is considered explicitly. It is found that the simplest correspondence between electron and nucleon-nucleus scattering is preserved for isovector excitations but not for isoscalar excitations under the usual assumptions for the tensor interaction. It is clear that precise comparisons between experiment and theory (or between probes) cannot be made unless these and related effects are consistently included.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 46277, 46678

46706 (INIS-mf—10946, pp 34-35) **Computerized system based on an IBM PC for radiation shielding calculations.** Faermann, S.; Neeman, E.; Tsechanski, A.; Brenner, S. (Soroca Medical Center, Beersheba, Israel. Dept. of Oncology; Ministry of Health, Tel-Aviv, Israel. Dept. of Rad. Safety; Ben-Gurion Univ. of the Negev, Beersheba, Israel. Dept. of Nuclear Engineering; Ministry of Health, Tel-Aviv, Israel. Res. Inst. for Environmental Health). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46707 **(SAND—87-1868C) Applications of the ITS codes.** Halbleib, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1987. Contract AC04-76DP00789. 15p. (CONF-8709115—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013063.

From International school of radiation damage and protection; Sicily, Italy (24 Sep 1987).

Results are presented for a great variety of applications of the member codes of the Integrated TIGER Series (ITS), a system of coupled electron/photon Monte Carlo transport codes. These applications range from the predictions of basic transport phenomena that involve relatively simple geometries and can be compared with precise experimental data to design calculations and analyses for describing transport in geometrically complex research facilities and experiments that often combine strongly competing effects of collisional and macroscopic field transport. The scope of these applications demonstrates the accuracy and flexibility of the system. 46 refs.

46708 (ZfI-Mitt—122, pp 177-186) **Mathematical description of properties of a weakly deformed Gauss peak. 3. Prove of the density function property of the modified correlation function.** Braune, M. Nov 1986. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87780160.

In Contributions to radiochemistry. Mathematical problems in modelling.

The article proves the density function property of the modified correlation function for two weakly deformed Gaussian peaks by integration. This density function property allows the calculation of peak shape parameters from multi-channel spectra using the higher moments.

46709 **Multigroup particle transport in a moving material.** Wienke, B.R.; Hill, T.R.; Whalen, P.P. (Applied Theoretical Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **72**: No. 1, 177-201(Sep 1987).

The linear Boltzmann equation is formulated against a moving material background in both Eulerian and Lagrangian representations. One-dimensional slab and spherical geometries and two-dimensional cylindrical geometry are treated. Material acceleration terms are expanded locally, effective cross sections and moving sources are defined, and the continuity equation is coupled to the transport equation in a consistent manner. Relative importances of material motion terms are discussed and a simple approximation to the material acceleration term is suggested. Standard multigroup representations for the material motion terms are obtained and an iteration strategy used to solve the transport equation is reviewed. Specific applications are presented and contrasted. copyright 1987 Academic Press, Inc.

6550 Medical Physics

REFER ALSO TO CITATION(S) 46206, 46253

46710 (BNL—39931) Variation in thyroid calibration efficiencies as a function of phantom design for I-125. Miltenberger, R.P.; Langille, E.; Sheetz, M.; Ricci, T. (Brookhaven National Lab., Upton, NY (USA); Niagara Mohawk Power Corp., Scriba, NY (USA); Pittsburgh Univ., PA (USA); Saint Paul Medical Center, Dallas, TX (USA). Dept. of Radiation Oncology). 1987. Contract AC02-76CH00016. 19p. (CONF-870705—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014294.

From Annual meeting of the Health Physics Society; Salt Lake City, UT, USA (5 Jul 1987).

Four commercially available thyroid phantoms were evaluated to determine the effect that choice of phantom would have on the determination of I-125 activity in the thyroid. Efficiency calibration values for a 5.0-cm diameter 1-mm thick NaI (Tl) detector were determined as a function of distance from the phantom along the central axis and at angles up to 45 off axis using I-125 as the radionuclide of interest. Results indicate that substantial variations in the estimate of radioactivity in the thyroid will occur based on choice of calibration phantom. Using the Humanoid System, Inc. Realistic Phantom as the reference phantom, one could experience differences in estimated activity in the human thyroid that range from 0.86 to 2.94. 6 refs., 6 figs., 3 tabs.

46711 (DOE/AL/31061—T1) Survey of DOE contractors' standards and calibration practices. (Metron Corp., Rancho Cucamonga, CA (USA)). 25 Mar 1987. Contract AC04-85AL31061. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013092.

The authors conducted a survey via a mailed questionnaire of Standards and Calibration (S and C) Practices at Department of Energy (DOE) nonweapon integrated contractors. This report summarizes survey findings, conclusions, and recommendations applicable to S and C practices at DOE non-weapon integrated contractors.

46712 (INIS-mf—10946, pp 20-25) Whole-body counting of photons in the energy range 10-2500 KeV by a Phoswich detector. Levinson, S.; Laichter, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1987. NTIS (US Sales Only), PC A04/MF A01. File Number DE87780161. (CONF-8704181—).

From Israel Health Physics Society annual meeting; Tel-Aviv, Israel (22 Apr 1987).

46713 (KURRI-TR—277, pp 21-27) Gamma-ray branching ratios of standard sources for γ-ray spectrometry. Baba, Hiroshi; Saito, Tadashi; Sakuraba, Youshuke; Baba, Sumiko. (Osaka Univ., Toyonaka, Japan. Faculty of Science). Apr 1986. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE87780156. (CONF-8602137—).

From 2. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (4 Feb 1986).

It has been nearly 15 years since the authors developed the BOB analysis code series for automatic γ-ray spectrometry. A key problem still remaining is how to incorporate calibration processes for energy and couting efficiency. /sup 152/Eu was selected as the multiple γ-ray source for Ge(Li) calibration. Recently it has been desired to estimate the sum effect which occurs when measurements are made near the detector and to determine the limit of the geometry within which /sup 152/Eu is effective as a standard source. The present study is aimed at determining: 1) the reliability of each γ-ray (including the accuracy of the γ-ray emission probability values currently used and the reproducibility in actual measurement), 2) the suitability as standard γ-rays and the likeliness to be affected by the sum effect, 3) in what form the sum effect appears (quantitative examination of the sum effect produced), 4) whether /sup 152/Eu serves as a standard source for large geometries, and 5) whether the sum effect can be corrected easily. Accurate counting efficiency curves are obtained by applying various standard sources to geometries where the sum effect can be ignored. It is found that some γ-rays from /sup 152/Eu are easily affected by the sum effect while others are not. Quantitative consideration is made to provide theoretical equations for correction of the sum effect. It is also shown that the problem of the correction for large geometries may be solved if the dependence of the photopeak counting efficiency on the geometry is known as a function of energy alone. (Nogami, K.).

46714 (ORNL/TM—8381/V1) Specific absorbed fractions of energy at various ages from internal photon sources: 1, Methods. Cristy, M.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87013345.

Specific absorbed fractions (PHI's) in various organs of the body (target organs) from sources of monoenergetic photons in various other organs (source organs) are tabulated. This volume outlines various methods used to compute the PHI-values and describes how the "best" estimates recommended by us are chosen. These PHI-values can be used in calculating the photon component of the dose-equivalent rate in a given target organ from a given radionuclide that is present in a given source organ. The International Commission on Radiological Protection recognizes that the endosteal, or bone surface, cells are the tissue at risk for bone cancer. We have applied the dosimetry methods that Spiers and co-workers developed for beta-emitting radionuclides deposited in bone to follow the transport of secondary electrons that were freed by photon interactions through the microscopic structure of the skeleton. With these methods we can estimate PHI in the endosteal cells and can better estimate PHI in the active marrow; the latter is overestimated with the methods at photon energies below 200 keV. 41 refs., 25 figs., 23 tabs.

46715 (ORNL/TM—8381/V2) Specific absorbed fractions of energy at various ages from internal photon sources: 2, One-year-old. Cristy, M.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 46p. NTIS, PC E03/MF A01; 1; GPO Dep. File Number DE87013346.

Specific absorbed fractions (PHI's) in various organs of the body (targets organs) from sources of monoenergetic photons in various other organs (source organs) are tabulated. In this volume PHI-values are tabulated for a one-year old or 9.8-kg person. These PHI-values can be used in calculating the photon component of the dose-equivalent rate in a given target organ from a given radionuclide that is present in a given source organ. The International Commission of Radiological Protection recognizes that the endosteal or bone surface, cells are the tissue at risk for bone cancer. We have applied the dosimetry methods that Spiers and co-workers developed for beta-emitting radionuclides deposited in bone to follow the transport of secondary electrons that were freed by photon interactions through the microscopic structure of the skeleton. With these methods we can estimate PHI in the endosteal cells and can better estimate PHI in the active marrow; the latter is overestimated with other methods at photon energies below 200 keV. 12 refs., 2 tabs.

46716 (ORNL/TM—8381/V3) Specific absorbed fractions of energy at various ages from internal photon sources: 3, Five-year-old. Cristy, M.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 46p. NTIS, PC E03/MF A01; 1; GPO Dep. File Number DE87013347.

Specific absorbed fractions (PHI's) in various organs of the body (target organs) from sources of monoenergetic photons in various other organs (source organs) are tabulated. In this volume PHI-values are tabulated for a five-year-old or 19-kg person. These PHI-values can be used in calculating the photon component of the dose-equivalent rate in a given target organ from a given radionuclide that is present in a given source organ. The International Commission on Radiological Protection recognizes that the endosteal, or bone surface, cells are the tissue at risk for bone cancer. We have applied the dosimetry methods developed for beta-emitting radionuclides deposited in bone to follow the transport of secondary electrons that were freed by photon interactions through the microscopic structure of the skeleton. With these methods we can esti-

mate PHI in the endosteal cells and can better estimate PHI in the active marrow; the latter is overestimated with other methods at photon energies below 200 keV. 12 refs., 2 tabs.

46717 **(ORNL/TM—8381/V4) Specific absorbed fractions of energy at various ages from internal photon sources: 4, Ten-year-old.** Cristy, M.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 47p. NTIS, PC E03/MF/A01; 1; GPO Dep. File Number DE87013348.

Specific absorbed fractions (PHI's) in various organs of the body (target organs) from sources of monoenergetic photons in various other organs (source organs) are tabulated. In this volume PHI-values are tabulated for a ten-year-old or 32-kg person. These PHI-values can be used in calculating the photon component of the dose-equivalent rate in a given target organ from a given radionuclide that is present in a given source organ. The International Commission on Radiological Protection recognizes that the endosteal, or bone surface, cells are the tissue at risk for bone cancer. We have applied the dosimetry methods that Spiers and co-workers developed for beta-emitting radionuclides deposited in bone to follow the transport of secondary electrons that were freed by photon interactions through the microscopic structure of the skeleton. With these methods we can estimate PHI in the endosteal cells and can better estimate PHI in the active marrow; the latter is overestimated with other methods at photon energies below 200 keV. 12 refs., 2 tabs.

46718 **(ORNL/TM—8381/V5) Specific absorbed fractions of energy at various ages from internal photon sources: 5, Fifteen-year-old male and adult female.** Cristy, M.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 47p. NTIS, PC E03/MF A01; 1; GPO Dep. File Number DE87013349.

Specific absorbed fractions (PHI's) in various organs of the body (target organs) from sources of monoenergetic photons in various other organs (source organs) are tabulated. In this volume PHI-values are tabulated for a fifteen-year-old male or an adult female (55 to 58 kg). These PHI-values can be used in calculating the photon component of the dose-equivalent rate in a given target organ from a given radionuclide that is present in a given source organ. The International Commission on Radiological Protection recognizes that the endosteal, or bone surface, cells are the tissue at risk for bone cancer. We have applied the dosimetry methods developed for beta-emitting radionuclides deposited in bone to follow the transport of secondary electrons that were freed by photon interactions through the microscopic structure of the skeleton. With these methods we can estimate PHI in the endosteal cells and can better estimate PHI in the active marrow; the latter is overestimated with other methods of Snyder et al. at photon energies below 200 keV. 12 refs., 2 tabs.

46719 **(ORNL/TM—8381/V6) Specific absorbed fractions of energy at various ages from internal photon sources: 6, Newborn.** Cristy, M.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 46p. NTIS, PC E03/MF A01; 1; GPO Dep. File Number DE87013350.

Specific absorbed fraction (PHI's) in various organs of the body (target organs) from sources of monoenergetic photons in various other organs (source organs) are tabulated. In this volume PHI-values are tabulated for a newborn or 3.4-kg person. These PHI-values can be used in calculating the photon component of the dose-equivalent rate in a given target from a given radionuclide that is present in a given source organ. The International Commission on Radiological Protection recognizes that the endosteal, or bone surface, cells are the tissue at risk for bone cancer. We have applied the dosimetry methods that Spiers and co-workers developed for beta-emitting radionuclides deposited in bone to follow the transport of secondary electrons that were freed by photon interactions through the microscopic structure of the skeleton. With these methods we can estimate PHI in the endosteal cells and can better estimate PHI in the active marrow; the latter is overestimated with other methods at photon energies below 200 keV. 12 refs., 2 tabs.

46720 **(ORNL/TM—8381/V7) Specific absorbed fractions of energy at various ages from internal photon sources: 7, Adult male.** Cristy, M.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 46p. NTIS, PC E03/MF A01; 1; GPO Dep. File Number DE87013351.

Specific absorbed fractions (PHI's) in various organs of the body (target organs) from sources of monoenergetic photons in various other organs (source organs) are tabulated. In this volume PHI-values are tabulated for an adult male (70-kg Reference Man). These PHI-values can be used in calculating the photon component of the dose-equivalent rate in a given target organ from a given radionuclide that is present in a given source organ. The International Commission on Radiological Protection recognizes that the endosteal, or bone surface, cells are the tissue at risk for bone cancer. We have applied the dosimetry methods developed for beta-emitting radionuclides deposited in bone to follow the transport of secondary electrons that were freed by photon interactions through the microscopic structure of the skeleton. With these methods we can estimate PHI in the endosteal cells and can better estimate PHI in the active marrow; the latter is overestimated with other methods at photon energies below 200 keV. 12 refs., 2 tabs.

46721 **(PB—87-206793/XAB) Federal radiation protection guidance for occupational exposure: response to comments.** (Office of Radiation Programs, Washington, DC (USA)). Jan 1986. 201p. (EPA—520/1-84/011). NTIS, PC A10/MF A01.

The U.S. Environment Protection Agency responds in the report to comments received on proposed Federal radiation-protection guidance for occupational exposure (46 F.R. 7836, January 23, 1981). An attempt was made to include all of the substanive comments received in writing and in public hearings. The Agency's response follows each of the comments.

46722 (SAAS—343, pp 25-34) **Personnel dosimetry in internal radiation exposure by excretory radionuclide measurement.** Balonov, M.I.; Bruk, G.Ya.; Korelina, N.F.; Likhtarev, I.A.; Repin, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780162. (CONF-8509389—Pt.3).

From Final conference on scientific-technological cooperation between the MoH of the USSR and the SAAS of the GDR; Tashkent, USSR (2 Sep 1985).

The collaboration with the SAAS resulted in the development of a mathematical method to calculate radiation doses in human tissues attributed to inhaled radionuclides concerning their retention dynamics in the respiratory system and their uptake into the blood as well as the metabolic pathways in the organs. Sanepstations and radiation protection service elaborated nomograms for the determination of the commitment doses in the critical organs based on the radionuclide content of a 24-hours urinalysis without intermediate calculations. Recommendations for the use of the method and the nomograms for various radionuclides (solubility classes D and N with MAAD of 1 and 10 μm) are given in the methodological document: Indirect dosimetry of inhaled radionuclides in workers. A calculation method for the annual dose of internal irradiation in tritium workers is also cited.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 45726, 45731, 45732, 45733, 45786, 45935, 46139, 46419, 46428, 46469, 46675

46723 **(AD-A—181620/6/XAB) Focused-ion-beam technology and applications.** Melngailis, J. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Apr 1987. 31p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Vacuum Science and Technology B, Vol. 5, No. 2, 469-495 (Mar/Apr 1987).

Ions of keV energies incident on a solid surface produce a number of effects: several atoms are sputtered off, several electrons are emitted, chemical reactions may be induced, atoms are displaced from their equilibrium positions, and ions implant themselves in the solid, altering its properties. Some of these effects, such as

sputtering and implantation are widely used in semiconductor device fabrication and in other fields. Thus, the capability to focus a beam of ions to submicrometer dimensions, i.e., dimensions compatible with the most-demanding fabrication procedures, is an important development. The focused-ion-beam field has been spurred by the invention of the liquid metal ion source and by the utilization of focusing columns with mass-separation capability. This has led to the use of alloy ion sources making available a large menu of ion species, in particular the dopants of silicon and gallium arsenides. The ability to sputter and to also induce deposition by causing breakdown of an adsorbed film has produced an immediate application of focused ion beams to photomask repair.

46724 **(BNL—40024) Neutron scattering study on the magnetic excitations in Mn_3Si.** Tomiyoshi, S.; Yamaguchi, Y.; Ohashi, M.; Cowley, E.R.; Shirane, G. (Brookhaven National Lab., Upton, NY (USA); Tohoku Univ., Sendai (Japan). Research Inst. for Iron, Steel and Other Metals; Rutgers--the State Univ., Camden, NJ (USA). Coll. of Arts and Sciences). 1987. Contract AC02-76CH00016. 9p. (CONF-8704171—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013305.

From International symposium on magnetism of intermetallic compounds; Kyoto, Japan (20 Apr 1987).

Magnetic excitations in an itinerant antiferromagnet Mn_3Si were measured up to an energy of 7 kT/sub N/ (15 MeV) at 5.5 K by inelastic scattering of neutrons. The dispersion cones emanating from a pair of magnetic satellite Bragg points intersect at 5 MeV and after that they combine into anisotropic excitations centered at a Brillouin zone boundary.

46725 **(BNL—40069) Neutron and x-ray scattering studies of premartensitic phenomena.** Shapiro, S.M. (Brookhaven National Lab., Upton, NY (USA); Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1987. Contract AC02-76CH00016. 13p. (CONF-8705168—1). NTIS, PC A02. File Number DE87013316.

From Workshop on competing interactions and microstructures: statics and dynamics; Los Alamos, NM, USA (5 May 1987).

This paper discusses neutron and x-ray investigations of some metallic alloys which are known to exhibit martensitic transformations. It is shown that precursor effects are usually present in the diffuse scattering and in the phonon dispersion curves, but the transition cannot be described in terms of the soft mode picture used in the Landau and Devonshire theory to describe structural phase transitions. In addition, it is noted that it is inappropriate to look at these microstructures as incommensurate systems, but more correctly as a coherent coexistence of two phases.

46726 **(CONF-870733—10) EXELFS [Extended Electron Energy Loss Fine Structure] of amorphous and crystalline SiC.** Angelini, P.; Sevely, J.C.; Hssein, K.; Zanchi, G. (Oak Ridge National Lab., TN (USA); Centre National de la Recherche Scientifique, 31 - Toulouse (France). Lab. d'Optique Electronique). Jul 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013551.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

Extended Electron Energy Loss Fine Structure (EXELFS) is a technique which is sensitive to the local atomic environment surrounding atoms. The ability to perform EXELFS measurements with the use of an electron microscope enables one to study materials properties at high spatial resolution. Its use as a method to evaluate amorphous materials is especially noteworthy since EXELFS is sensitive to the structure and composition within near neighbor distances of specific types of atoms. The materials used in this study included single crystal SiC, single crystal SiC made amorphous by ion implantation with chromium, and single crystal SiC made amorphous under a converged 300 kV electron beam. EXELFS results, based upon the Si K edge, exhibit significant differences for crystalline SiC versus the SiC made amorphous by ion implantation. The position of peaks in the radial distribution function (RDF), representing the Si-C and the Si-Si interatomic bonds, indicate an expansion in the nearest neighbor distances for the ion implanted amorphous SiC. Also the Si-Si/Si-C peak intensity ratio for the amorphous material was significantly lower than that for crystalline SiC. These results imply that the tetrahedral (Si-C) bonds are retained to a greater degree than the longer Si-Si bonds. A loss in coordination of the Si-Si bond indicates that the unit cell has undergone substantial damage.

46727 **(CONF-8708110—3) Plasmon resonance absorption in layered structures of silver with periodic corrugation.** Arakawa, E.T.; Inagaki, T.; Goudonnet, J.P. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87013183.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

Plasmon resonance absorption in periodically corrugated layered structures of silver was studied by the photoacoustic method. The layered structures were self-supporting and corrugated with a period of 1888 nm and amplitude varying from 6 to 12 nm, depending on the thickness. Experimental results of resonance absorption of 633-nm photons were analyzed in terms of the propagation and damping constants of coupled modes of surface plasmons. The coupling efficiency of incident photons to these modes was found to be strongly dependent on corrugation amplitude and layer thickness.

46728 **(CONF-8708117—1) SANS [small-angle neutron scattering] from polymers and colloids.** Hayter, J.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013548.

From Neutron scattering symposium on advances and applications; Sydney, Australia (8 Aug 1987).

Small-angle neutron scattering (SANS) has been remarkably successful in providing detailed quantitative structural information on complex everyday materials, such as polymers and colloids, which are often of considerable industrial as well as academic interest. This paper reviews some recent SANS experiments on polymers and colloids, including ferrofluids, and discusses the use of these apparently complex systems as general physical models of the liquid or solid state.

46729 **(CONF-8709116—3) Comparison of fractal and pore models for electrolyte/electrode interfaces.** Wang, J.C. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013681.

From 6. international conference on solid state ionics; Garmisch-Partenkirchen, F.R. Germany (6 Sep 1987).

Fractal and pore models connecting the fractional-power frequency dependence of the impedance of an electrolyte/blocking electrode interface to the interface microstructure are compared. It is demonstrated that Liu's fractal model is similar to a pore model because of the way the fractal interface is constructed; the validity of the relation between the fractal dimension D and the impedance frequency exponent n derived by Liu depends crucially on the way the fractal dimension is defined; and the relation between D and n derived by Nyikos and Pajkossy is questionable because the assumption that their fractal interfaces have a fractional-power-law impedance is inconsistent with our numerical results.

46730 **(DOE/ER/45233—2) Application of spin-sensitive electron spectroscopies to investigations of electronic and magnetic properties of solid surfaces and epitaxial systems: Progress report, 1 January 1987-31 December 1987.** Walters, G.K.; Dunning, F.B. (Rice Univ., Houston, TX (USA)). Aug 1987. Contract FG05-86ER45233. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014235.

Research during the second year of this grant has focussed on: (1) investigation of surface magnetic structure of Ni(lll) by Spin-Polarized Low Energy Electron Diffraction (SPLEED) and overhaul of the apparatus to incorporate additional spin-dependent electron spectroscopies and epitaxial growth capabilities; and (2) investigation of dynamics of metastable atom deexcitation at magnetic and adsorbate-covered surfaces using Spin-Polarized Metastable Deexcitation Spectroscopy (SPMDS).

46731 **(IC—86/310) H/sub g/Te-CdTe phase diagrams calculation by RAS model.** Hady, A.A.A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703062.

The model of Regular Associated Solutions (RAS) for binary solution, which extended onto the ternary solution was used for Mercury-Cadnium-Tellurim phase diagrams calculations. The function of dissociation parameters is used here as a function of temperature and it is independent of composition. The ratio of mole fractions has a weak dependence on temperature and is not neglected. The calculated liquidus binary temperature and the experimental one are so fitted to give the best values of parameters used to calculate the HgTe-CdTe phase diagrams. 15 refs, 5 figs, 2 tabs.

46732 **(IC—86/314) Inertial transient dynamics of the sliding charge density wave systems.** Dong Jinming; Yu Lu. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703065.

The singular perturbation method is used in this note to study the effects of the inertial term in the single particle model for the charge density wave systems mainly in the sliding regime. The inertial term leads to the "ringing" phenomena when a pulse field is applied. The theoretical results are qualitatively consistent with the experimental observations. 14 refs, 3 figs.

46733 **(IC—86/374) Anelastic behaviour of materials under multiaxial strains. III: Order-disorder transition, Snoek effect and Poisson's ratio in AISI-1080 steel.** Bolmaro, R.E.; Povolo, F. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703087.

Data on Young's modulus and Poisson's ratio obtained in AISI-1080 steel, in the temperature region between about 300 and 600 K, are presented. The measurements have been performed in longitudinal excitation and several harmonics were used, to obtain Poisson's ratio from the measured resonant frequencies. The maximum observed in the temperature dependence of Young's modulus, for the fundamental resonant frequency, is attributed to a stress-induced disordering of carbon atoms in the octahedral interstices of the martensitic matrix. The increases of Young's modulus with temperature are described in terms of expressions deduced in the paper, which are based on Landau theory of second order phase transitions. The critical temperature is related to the M/sub s/ and M/sub f/ temperatures which characterize the martensitic phase transition. Finally, the temperature dependence of Poisson's ratio is described in terms of a theory of anelastic behaviour under multiaxial strains, based on the standard anelastic solid model. 23 refs, 5 figs, 1 tab.

46734 **(INIS-SU—405) Experimental study of the de Haas-van Alphen effect in the intermetallic compound Cd/sub 3/Mg.** Fenster, M.Ya.; Khotkevich, V.V.; Pluzhnikov, V.B. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1985. 33p. (In Russian). (Preprint-no—17-85). NTIS (US Sales Only), PC A03/MF A01. File Number DE87703108.

De Haas-van Alphen oscillations are observed in the ordered intermetallic compound Cd/sub 3/Mg at 1.5 to 4.2 K in the field up to 70 kG. The detailed description of the experimental technology is given. Methods are discussed for high-accuracy analysis of oscillatory data using the discrete fast Fourier transform. It was found that the Fermi surface of Cd/sub 3/Mg has a complicated form not similar to that of cadmium or magnesium. A comparison of the experimental data with pseudopotential band structure calculations is carried out. 30 refs.; 14 figs.

46735 **(INIS-SU—407) Electronic structure of ordered intermetallic compounds Cd/sub 3/Mg and Mg/sub 3/Cd.** Khotkevich, V.V.; Svechkarev, I.V.; Pluzhnikov, V.B.; Grechnev, G.E. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 24p. (In Russian). (Preprint-no—22-86). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703110.

The de Haas-van Alphen (DHvA) effect is studied experimentally in the intermetallic compound Cd/sub 3/Mg. More than seven separate dHvA frequency brunches are observed and several effective masses and Dingle temperatures are determined. The band structure calculations based on the semiempirical pseudopotentials are carried out both for Cd/sub 3/Mg and Mg/sub 3/Cd to construct the Fermi surfaces (FS) of these compounds. It is possible to propose the explanation of dHvA frequency brunches in Cd/sub 3/Mg using the calculated angle dependence of FS extremal cross sections. The role of spin-orbit interaction effects in Cd/sub 3/Mg electron band spectrum and FS formation is discussed. 17 refs.; 10 figs.; 2 tabs.

46736 **(LA-UR—87-1910) Complex scattering dynamics and the integer quantum Hall effect.** Trugman, S.A.; Waugh, F.R. (Los Alamos National Lab., NM (USA); Princeton Univ., NJ (USA). Dept. of Physics). 1987. Contract W-7405-ENG-36. 7p. (CONF-870774—1). NTIS, PC A02/MF AO1; 1; GPO Dep. File Number DE87011790.

From 7. electronic properties of two-dimensional systems; Santa Fe, NM, USA (27 Jul 1987).

The effect of a magnetic field on potential scattering is investigated microscopically. A magnetic field renders the scattering of a classical charged particle far more complex than previously suspected. Consequences include possible 1/f noise and an explanation of the observed breakdown of the quantum Hall effect at large currents. A particular scatterer is described by a discontinuous one dimensional Hamiltonian map, a class of maps that has not previously been studied. A renormalization group analysis indicates that singular behavior arises from the interplay of electron orbits that are periodic and orbits that are quasiperiodic.

46737 **(LA-UR—87-2272) Vibrational spectroscopy of shock-compressed fluid N_2 and O_2.** Schmidt, S.C.; Moore, D.S.; Shaw, M.S.; Johnson, J.D. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—60). NTIS, PC A02/MF A01; GPO Dep. File Number DE87013138.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Single-pulse, multiplex, coherent anti-Stokes Raman scattering (CARS) was used to observe the vibrational spectra of liquid N_2 shock-compressed to several pressures and temperatures up to 41 GPa and 5200 K and liquid O_2 shock-compressed to several pressures and temperatures up to 10 GPa and 1000 K. For N_2, the experimental spectra were compared to synthetic spectra calculated using a semiclassical model for CARS intensities and estimated vibrational frequencies, peak Raman susceptibilities and Raman line widths. The question of excited state populations in the shock-compressed state is addressed.

46738 **(LA-UR—87-2273) Experimental molecular spectroscopy in shock-compressed materials.** Moore, D.S.; Schmidt, S.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-870753—61). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013139.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Shocked materials present an exciting challenge to the experimental spectroscopist. The severe constraints in time and space imposed by the shock process can also be accompanied by chemical complexity. Many standard spectroscopic techniques have recently been adapted with varying degrees of success. Those discussed here are uv/visible absorption, emission, and fluorescence, infrared absorption, and spontaneous and coherent Raman scattering. The importance of the connection to both theory and static high-pressure methods is emphasized.

46739 (LA-UR—87-2283) Rarefaction velocities in shocked lead. Boness, D.A.; Brown, J.M.; Shaner, J.W. (Los Alamos National Lab., NM (USA); Washington Univ., Seattle (USA). Graduate Program in Geophysics). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—59). NTIS, PC A02. File Number DE87013141.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

By use of the optical analyzer technique, the bulk sound velocity in shocked lead has been measured at nine points along its Hugoniot in the pressure range 54.5 to 380 GPa. The lowest-pressure points exhibit no sign of solid behavior. The bulk sound velocity is essentially linear with respect to density, and the Gruneisen parameter, γ, fails to follow a constant $p\gamma$ model. Results are consistent with zero-pressure values.

46740 (LBL—22906) Optical second harmonic generation from Langmuir-type molecular monolayers. Berkovic, G.; Rasing, Th.; Shen, Y.R. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098. 8p. (CONF-8708110—7). NTIS, PC A02. File Number DE87014075.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A single molecular layer is generally sufficient to produce observable optical second harmonic generation (SHG). Furthermore, the selection rules governing this process make the SHG from a single monolayer often stronger than that from the medium supporting the monolayer. We have studied SHG from various Langmuir-type monolayers (i.e., monolayers spread on a water surface) in the following contexts: Study of chemical reactions (e.g., polymerization) and two-dimensional phase transitions in molecular monolayers on water. Development of a new technique to evaluate optical nonlinear coefficients of organic molecules, and their relationship to the molecular structure.

46741 (LBL—23509) High dose uranium ion implantation into silicon. Brown, I.G.; Galvin, J.E.; Yu, K.M. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013964.

Implantation of uranium ions into silicon to a maximum dose of 6×10^{16} atoms/cm^2, with a maximum concentration of 6×10^{21} atoms/cm^3, has been carried out. This concentration corresponds to 12 at. % of uranium in the silicon host material. The implanted uranium content was measured by Rutherford backscattering and confirmed by a measurement of the alpha-particle activity of the buried uranium layer. The range and straggling of the uranium, and sputtering of the silicon target by uranium, were measured and are compared with theoretical estimates. The implantation was performed at an ion mean energy of 157 keV using a new kind of high current metal ion source.

46742 (LBL—23676) Second-harmonic and sum-frequency generation for surface studies. Hunt, J.H.; Guyot-Sionnest, P.; Shen, Y.R. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 7p. (CONF-8706128—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014081.

From 8. international conference on laser spectroscopy; Are, Sweden (22 Jun 1987).

Second harmonic generation (SHG) has now been well established as a versatile surface-sensitive probe. It has been used to study electrochemical processes at electrode surfaces, molecular adsorption and desorption at metal and semiconductor surfaces, orientational phase transition of molecular monolayers on water, surface reconstruction and epitaxial growth, and so on. More recently, it has been employed as a tool to monitor monolayer polymerization and other surface reactions, to probe polar order of molecules at interfaces, and to measure molecular nonlinearity. While most surface techniques are restricted to the solid/vacuum environment, SHG is applicable to nearly all interfaces as long as the interfaces are accessible by light. In addition, SHG has the advantages of being capable of in-situ measurements with high temporal, spatial, and spectral resolutions.

46743 (PSD—87) Proceedings of the European Meeting on Positron Studies of Defects. (Martin-Luther-Universitaet Halle-Wittenberg, Halle (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1987. 191p. (CONF-8703162—). NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128.

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

The meeting dealt with both theoretical and experimental aspects of positron studies of defects using conventional and novel positron techniques. The subjects are indicated in the following headings: (1) theory of positrons in imperfect solids, (2) vacancies in metals and alloys, (3) dislocation and deformation effects, (4) amorphous alloys and fine-grained materials, (5) phase transitions, (6) precipitation phenomena, (7) gas impurity-defect interaction and irradiation effects, (8) defects in elemental semiconductors, (9) defects in compound semiconductors, (10) slow positron studies of defects, (11) defects in oxides and halides, (12) defects in molecular solids, and (13) advances in experimental techniques and data treatment. Althogether 141 contributions (invited plenary lectures, short lectures, and posters) are presented as titles with abstracts. Most of them are in INIS scope and are processed individually for the database.

46744 (PSD—87, pp vp) Theoretical aspects of positrons in imperfect solids. Puska, M. (Helsinki Univ. of Technology, Espoo, Finland). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46745 (PSD—87, pp vp) Electron and positron states in disordered alloys. Mijnarends, P.E. (Netherlands Energy Research Foundation, Petten). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46746 (PSD—87, pp vp) Vacancies in metals and alloys. Siegel, R.W. (Argonne National Lab., IL). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46747 (PSD—87, pp vp) Properties of amorphous and fine-grained alloys. Kajcsos, Z. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46748 (PSD—87, pp vp) Positron studies of order-disorder and phase transitions in metals and alloys. Mikhalenkov, V.S. (Institute Metallofiziki, Kiev, USSR). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46749 (PSD—87, pp vp) Positron studies of decomposition phenomena in Al-alloys. Krause, R.; Dlubek, G.; Bruemmer, O. (Martin-Luther-Universitaet Halle-Wittenberg, Halle, German Democratic Republic). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46750 (PSD—87, pp vp) **Gas-impurity defect interaction in solids.** Petersen, K. (Technical Univ. of Denmark, Lyngby). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46751 (PSD—87, pp vp) **Study of positron diffusion in solids by positron spin relaxation (e^+SR) experiments.** Seeger, A.; Major, J.; Banhart, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart, Germany, F.R.; Stuttgart Univ., Germany, F.R.). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46752 (PSD—87, pp vp) **Defects and oxygen in silicon.** Dannefaer, S. (Winnipeg Univ., Manitoba). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46753 (PSD—87, pp vp) **Defects in semiconductor compounds.** Dlubek, G. (Paedagogische Hochschule N.K. Krupskaja, Halle, German Democratic Republic). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46754 (PSD—87, pp vp) **Near-surface defect profiling with slow positrons.** Vehanen, A. (Helsinki Univ. of Technology, Espoo, Finland). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46755 (PSD—87, pp vp) **Defects in molecular solids.** Goworek, T. (Uniwersytet Marii Curie-Sklodowskiej, Lublin, Poland). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46756 (PSD—87, pp SL1) **Migration stage of divacancies in quenched pure aluminium, dilute aluminium alloys, and pure copper studied by positron annihilation.** Kanazawa, I.; Murakami, H.; Doyama, M. (Tokyo Gakugei Univ., Koganei, Japan; Tokyo Univ., Japan). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46757 (PSD—87, pp SL2) **Positron lifetime and Moessbauer spectroscopy study of the vacancy-impurity interaction in dilute Al-Sn alloys.** Szeles, C.; Suevegh, K.; Vertes, A. (Roland Eoetvoes Univ., Budapest, Hungary). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46758 (PSD—87, pp SL3) **Effects of lattice anisotropy on positron parameters in In-Pb alloys.** Belaidi, A.; West, R.N. (East Anglia Univ., England). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46759 (PSD—87, pp SL4) **Positron-dislocation interaction in deformed Zn and Cd.** Hidalgo, C.; Diego, N. de; Linderoth, S. (Universidad Complutense de Madrid, Spain; Technical Univ. of Denmark, Lyngby). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46760 (PSD—87, pp SL5) **Nanocrystalline metals and semiconductors studied by positron lifetime.** Wuerschum, R.; Scheytt, M.; Schaefer, H.E. (Stuttgart Univ., Germany, F.R.). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46761 (PSD—87, pp SL6) **Positron study of the order-disorder transition in an $MgCd_3$ alloy.** Belaidi, A.; Coleman, P.G.; West, R.N. (East Anglia Univ., England). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46762 (PSD—87, pp SL7) **Positron annihilation study of precipitation effects in CuIn and CuSb alloys.** Luehr-Tanck, W.; Sager, A.; Ederhof, M.; Bosse, H. (Goettingen Univ., Germany, F.R.). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46763 (PSD—87, pp SL8) **Positron annihilation study of clustering of Ag atoms in quenched Al-1 at% Ag alloy.** Bharathi, A.; Sundar, C.S.; Gopinathan, K.P. (Indira Gandhi Centre for Atomic Research, Kalpakkam, India). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46764 (PSD—87, pp SL9) **Trapping rates into cavities in Al: temperature and size effects.** Jensen, K.O.; Eldrup, M. (Risoe National Lab., Roskilde, Denmark). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46765 (PSD—87, pp SL10) **Positron annihilation studies on neutron irradiated reactor pressure vessel steels.** Ghazi-Wakili, K.; Brunner, J.; Heinrich, F.; Zimmermann, U.; Waeber, W.B. (Eidgenoessische Technische Hochschule, Zurich, Switzerland; Swiss Federal Institute for Reactor Research, Wuerenlingen). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46766 (PSD—87, pp SL12) **Defect characteristics in different crystallographic directions in CZ-Si as a function of doping and annealing.** Puff, W.; Dannefaer, S.; Mascher, P.; Kerr, D. (Technische Univ., Graz, Austria; Winnipeg Univ., Manitoba). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46767 (PSD—87, pp SL13) **Thermal effect observed by positron annihilation techniques in electron irradiated silicon.** Moser, P.; Gupta, A.S.; Corbel, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46768 (PSD—87, pp SL14) **Positron trapping after electron irradiation in GAAS.** Corbel, C.; Pierre, F.; Geffroy, B.; Stucky, M.; Moser, P.; Hautojarvi, P.; Plazaola, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France; CEA Centre d'Etudes Nucleaires de Grenoble, 38, France; Helsinki Univ. of Technology, Espoo, Finland). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46769 (PSD—87, pp SL15) **Light-induced positron studies of defects in amorphous silicon.** Gang Liu; Ai-Lien Jung; Wei-Zong. (Beijing Institute of Aeronautics and Astronautics, Beijing, China; Qinghua Univ., Beijing, BJ, China). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46770 (PSD—87, pp SL16) **Investigation of defects in GaP using positron annihilation.** Zhou Bizhong; Fong Jiangling; Huan Jingzhao. (Xiamen Univ., FJ, China). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46771 (PSD—87, pp SL17) **Positron mobility measurements and their relevance to defect studies in semiconductors.** Beling, D.; Fung, S.; Wai, J. (Univ. College, London, England). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46772 (PSD—87, pp SL18) **Positron lifetime measurements with a pulsed beam of slow positrons.** Schoedlbauer, D.; Koegel, G.; Sperr, P.; Triftshaeuser, W. (Muenchen Univ., Germany, F.R.). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46773 (PSD—87, pp SL19) **Annihilation of positrons trapped at metal-dielectric interface.** Ewertowski, R.; Swiatkowski, W. (Wroclaw Univ., Poland). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46774 (PSD—87, pp SL20) **Some principles of positron annihilation studies of polymer systems.** Goldanskii, A.; Onischuk, V.; Shantarovich, V. 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46775 (PSD—87, pp SL21) **Study of elastomer structure microdefects by positron annihilation method.** Arifov, P.U.; Vasserman, S.N.; Tishin, S.A. (Institute Ehlektroniki, Tashkent, USSR). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46776 (PSD—87, pp vp) **Irradiation induced defects in semiconductor compounds.** Bourgoin, J.C.; Bardeleben, H.J. von. (Paris-7 Univ., 75, France). 1987. NTIS (US Sales Only), PC A09/MF A01. File Number DE87703128. (CONF-8703162—).

From European meeting on positron studies of defects; Wernigerode, German D.R. (23 Mar 1987).

46777 (SAND—87-1138C) **Multidimensional elemental analysis with the Sandia nuclear microprobe.** Doyle, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8709120—1). NTIS, PC A02. File Number DE87014158.

From International symposium on applications of ion beams in materials science; Tokyo, Japan (2 Sep 1987).

It is well known that many of the ion beam analysis techniques such as Rutherford backscattering spectrometry, elastic recoil detection, resonant and nonresonant nuclear reaction analysis can be used to nondestructively obtain concentration depth profiles of elements in solids. When these techniques are combined with the small beam spot capabilities of a scanned nuclear microprobe, sample composition can be determined in up to three dimensions. This paper will review the various procedures used to collect and analyze multidimensional data using the Sandia nuclear microprobe. In addition, examples of how these data are being used in the study of materials will be shown.

46778 (SAND—87-1773C) **Solute segregation to phase interfaces and grain boundaries: Studies by analytical electron microscopy and profile deconvolution.** Romig, A.D. Jr.; Cieslak, M.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 21p. (CONF-870733—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012129.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

Mathematical deconvolution of the observed composition profiles at the interface or boundary with the x-ray generation profile to determine the actual composition profile is a viable procedure for extracting compositional data on a spatial scale smaller than the inherent resolution of thin foil x-ray microanalysis. In sufficiently thin foils, the x-ray generation profile can be calculated with the single scattering model. In thicker foils, the x-ray generation profile can be calculated with Monte Carlo techniques. Explicit deconvolution is, in general, not possible mathematically, but it can be accomplished numerically through iterative convolutions. Convolution of the x-ray generation profile with the assumed actual composition profile allows for direct calculation of the expected composition profile. The convolution procedure using various assumed actual concentration profiles is repeated iteratively until the calculated profile and the observed profile correspond. This paper describes the convolution process and introduces a rapid graphical solution to the problem, compares the convolution process using the single scattering model and Monte Carlo techniques, and discusses the limitations of the deconvolution procedure. This study uses the recently reported data of Ti enrichment at grain boundaries in an Fe-Ni superalloy (Alloy 800).

46779 (SAND—87-2038C) **Photoluminescence studies of GaAs/AlAs superlattices.** Jones, E.D.; Drummond, T.J.; Hjalmarson, H.P.; Schirber, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8708112—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013817.

From 3. international conference on superlattices, microstructures and microdevices; Chicago, IL, USA (17 Aug 1987).

Low-temperature pressure-dependent photoluminescence measurements on short-period GaAs/AlAs superlattice structures are presented. Measurements show that the lower energy conduction-band states are in the AlAs layers and the highest energy valence-band states are located in the GaAs layers. This result is supported by the following three experimental observations: the observed pressure coefficient for the conduction-band to valence-band transition energy is negative, the magnetic mass of this transition is "heavy", and the band-to-band absorption coefficient appears to be small. These experimental observations are in agreement with predictions of tight-binding calculations.

46780 **(UCRL—95811) "Hot spots": Subnanometer femtosecond energy localization.** Karo, A.M.; Hardy, J.R. (Lawrence Livermore National Lab., CA (USA); Nebraska Univ., Lincoln (USA). Behlen Lab. of Physics). Dec 1986. Contract W-7405-ENG-48. 7p. (CONF-8702103—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010276.

From 11. international colloquium on dynamics of explosions and reactive systems; Warsaw, Poland (2 Feb 1987).

In a condensed energetic material an understanding of the dynamics and microscopic mechanisms underlying energy transfer between a shock front and various defects is of prime importance for a realistic description of "hot spot" formation and explosives initiation. A wide variety of simulations using the well-established technique of computer molecular dynamics has enabled us to obtain a general and very useful microscopic description of the processes beneath the macroscopic behavior of shocked systems. The calculation of the influence of heterogeneities such as point and line defects, voids, and grain boundaries is made possible by computer codes that can handle totally heterogeneous dynamical systems and track the dynamics of energy concentration and partitioning among the molecular bonds in the defect and the nearby region. One and two-dimensional calculations will be discussed in which the spatial and temporal dependence of the energy flux in a general lattice-defect system is calculated quantitatively as a function of shock strength, initial temperature, and initial parameters defining the lattice and defect.

46781 **(UCRL—95904) Damage resistance and crystal growth of KDP [potassium dihydrogen phosphate].** Cooper, J.F.; Singleton, M.F. (Lawrence Livermore National Lab., CA (USA)). 8 Jan 1987. Contract W-7405-ENG-48. 13p. (CONF-860880—55). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011555.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

An investigation is reported of the dependence of laser-damage site density on fluence and on various parameters of crystal growth and post-growth treatment. Damage site density (number of defects per unit volume) was found to increase monotonically with fluence (for single 1-ns pulses of 1.06 μm laser light). Site density (at a fluence of 10 J/cm^2) was influenced by solution flow rate, seed defect removal prior to growth, quaternary ammonium cations, and thermal cycling following growth. No dependence of damage susceptibility on growth rate was found over the range 3 to 30 mm/d. A model is presented which postulates the electrostatic adsorption of organic material onto the growing crystal surface and subsequent inclusion into the crystal. According to the model, damage occurs by absorption of light by inclusions of solution-wetted organic debris, resulting in pressure increase and hydraulic fracture of the surrounding crystal.

46782 **(UCRL—96019) A finite element model for induction heating of a metal crucible.** Gresho, P.M.; Derby, J.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 16p. (CONF-870799—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014246.

From American conference on crystal growth; Monterey, CA, USA (13 Jul 1987).

In support of a combined theoretical and experimental program designed to grow large oxide crystals at Lawrence Livermore National Laboratory, we have developed a quantitative model of the induction heating process for the Czochralski crystal growth technique. When integrated into the overall thermo-capillary-hydrodynamic model, this sub-model will provide the driving force for the entire process by describing the spatially-varying heat generation rate in the metal crucible. Herein we present the development of this sub-model and apply it to some typical cases of interest.

46783 **(UCRL—96492) Three phase carbon EOS model with electronic excitation.** van Thiel, M.; Ree, F.H.; Grover, R. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—56). NTIS, PC A02. File Number DE87013109.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A simple and rapid way for computing EOS data of multiphase solids with a liquid phase is described with emphasis on carbon. The method uses a scaling model for the liquid phase and includes a provision for electronic effects. The free energy minimum determines the stable phase.

46784 **(UCRL—96528) The dissociation of dense liquid nitrogen and shock cooling.** Ross, M. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 6p. (CONF-870753—53). NTIS, PC A02. File Number DE87013490.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

A theoretical model is used to examine the dissociation of shock-compressed liquid nitrogen. An important feature of the model is the introduction of a binding energy for the atomic state which leads to a volume-dependent dissociation energy. The model correctly predicts the highly unusual feature of shock cooling which is shown to be the consequence of the volume dependent dissociation energy.

46785 **(UCRL—96553) Why linear Birch and U/sub s/-U/sub p/ expansions work.** Grover, R. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 5p. (CONF-870753—49). NTIS, PC A02. File Number DE87013220.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

The equivalence of the Birch-Murnoghan equation to a linear U/sub s/-U/sub p/ equation was illustrated in the previous paper. Here it is shown in a direct manner how the virial theorem boundary localization of valence electron kinetic energy changes lead to the convergence of the Eulerian strain expansion about the zero-pressure state.

46786 **Dendritic sidebranching in the three-dimensional symmetric model in the presence of noise.** Langer, J.S. (Institute for Theoretical Physics, University of California, Santa Barbara, California 93106). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 7, 3350-3358(1 Oct 1987).

The time-dependent behavior of sidebranching deformations in the three-dimensional symmetric model of dendritic solidification is studied within a WKB approximation. Localized wave packets generated by pulses in the neighborhood of the tip are found to grow in amplitude and to spread and stretch as they move down the sides of the dendrite. This behavior is shown to imply that noise in the solidifying medium is selectively amplified in such a way as to produce a fluctuating train of sidebranches in qualitative agreement with experimental observations. A rough estimate indicates that purely thermal noise is probably not quite strong enough to fit the data.

46787 **Thermoelectric power fluctuations.** Esposito, F.P.; Goodman, B.; Ma, M. (Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 8, 4507-4509(15 Sep 1987).

We consider the fluctuations of the thermoelectric transport coefficients due to quantum interference. At low temperatures the relative fluctuations in these coefficients are substantially enhanced over the relative conductance fluctuations and result in random

sign changes in the coefficients. We suggest a simple experiment to measure these effects for L>L/sub in/.

46788 **Extreme-ultraviolet light emission from 50-MeV H^0 impact on aluminum.** James, D.R.; Sauers, I.; Arakawa, E.T. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6123). *Physical Review [Section] B: Condensed Matter;* **36**: No. 8, 4458-4461(15 Sep 1987). Contract AC05-84OR21400.

The first measurements are reported of extreme-ultraviolet light emission in the range 1.0—110 nm from the surface of an Al foil during bombardment from a 50-MeV atomic hydrogen beam. Beam currents were varied from 7.5 x 10/sup -9/ to 6.5 x 10/sup -4/ particle amps. The integrated photon yield was found to be 0.04—0.4 photons per incident atom and is discussed in terms of different emission mechanisms.

46789 **Self-energy shifts in heavily doped, polar semiconductors.** Sernelius, B.E. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **36**: No. 9, 4878-4887(15 Sep 1987). Contract AC05-84OR21400.

We present theoretical results for the self-energy shifts due to the interactions in a heavily doped, polar semiconductor. For the purpose of numerical demonstration we apply the results to n-type CdS. The density of states for both the majority and minority carriers are calculated in the region near the band edges. The polar coupling modifies the self-energy shifts, and new structures appear in the density of states, both above and below the Fermi level. At least some traces of these structures should be observed in experiments. Furthermore, the doping-induced band-gap narrowing is determined and we compare the obtained results with those from the much simpler so-called ϵ_0 approximation.

46790 **Functionals of the ground-state energy and the band gaps of semiconductors and insulators.** Rasolt, M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **36**: No. 9, 5041-5043(15 Sep 1987). Contract AC05-84OR21400.

We argue that the functional density for the energy of a semiconductor is nonanalytic in the density. Formal expansions in powers of the density, which are at the core of the local-density and gradient-expansion approximations, cannot be rigorously valid for macroscopic systems with energy gaps in the excitation spectrum.

46791 **Dipole radiation in a multilayer geometry.** Reed, C.E.; Giergiel, J.; Hemminger, J.C.; Ushioda, S. (Department of Physics, School of Physical Sciences, University of California, Irvine, California 92717). *Physical Review [Section] B: Condensed Matter;* **36**: No. 9, 4990-5000(15 Sep 1987).

There are several kinds of experiments that can be done with multilayer stacks of dielectric media which require an understanding of light emission by sources within the stack for their analysis. These experiments may involve, for example, light-emitting tunnel junctions, Raman scattering in Kretschmann and other multilayered geometries, and Rayleigh scattering by small amounts of surface or interface roughness, either alone or in combination with other processes. A set of electromagnetic Green's functions for a multilayer stack of isotropic dielectric media [D. L. Mills and A. A. Maradudin, Phys. Rev. B 12, 2943 (1975)] gives the electric fields produced everywhere by a point source of current oscillating at a frequency f. These Green's functions can thus be used to solve this type of problem. In this paper we show how these Green's functions can be written in terms of 2 x 2 transfer matrices of the type commonly used to find the fields in a dielectric stack due to an incident plane wave. With this simplification we can easily evaluate the Green's functions for a stack with an arbitrary number of layers. We further show that, when the electric fields generated by a point source within the stack are evaluated far away, they can be written directly in terms of the electric fields that would be generated at the location of the current source by plane waves incident from the direction of the observation point. We show that this follows from the Lorentz reciprocity theorem. Thus, in this case the formalism of Green's functions is not needed.

46792 **Calculation of specific heat and susceptibilities with the use of the Trotter approximation.** Fye, R.M.; Scalettar, R.T. (Department of Physics, University of California, San Diego, La Jolla, California 92093). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 3833-3843(1 Sep 1987).

The Trotter approximation has been used extensively in quantum Monte Carlo simulations. We consider here different ways of calculating the general zero-field susceptibility chi and the specific heat C when a Trotter approximation is used, deriving analytically the error dependence on the imaginary-time increment Δtau as well as the low-temperature behavior. We find that certain definitions of chi and C exhibit spurious divergences at low temperatures, and suggest the most appropriate ways to extract these quantities. We test our general predictions on two models, and discuss the implications of our results for numerical simulations.

46793 **Neutron-scattering observations of extreme critical slowing down in a d = 3 random-field system.** Belanger, D.P.; Jaccarino, V.; King, A.R.; Nicklow, R.M. (Department of Physics, University of California, Santa Cruz, California 95064). *Physical Review Letters;* **59**: No. 8, 930-933(24 Aug 1987).

Extreme critical slowing down of the order-parameter fluctuations in a d = 3 random-field Ising model system is observed in quasielastic-neutron-scattering studies of Fe/sub 0.46/Zn/sub 0.54/F_2. This is manifest in the logarithmic time dependence of I(q) in the 30—10^4-sec time domain at, and near, T/sub c/(H) in zero-field—cooled measurements. Contrary to a report by others, T/sub eq/(H)>T/sub c/(H) and no evidence for a first-order phase transition is found in this virtually gradient-free crystal.

46794 **Accurate estimate of ν for the three-dimensional Ising model from a numerical measurement of its partition function.** Bhanot, G.; Salvador, R.; Black, S.; Carter, P.; Toral, R. (Physics Department and Supercomputer Computations Research Institute, The Florida State University, Tallahassee, Florida 32306). *Physical Review Letters;* **59**: No. 7, 803-806(17 Aug 1987).

We give results from an accurate determination of the partition function of the three-dimensional Ising model on lattices of size up to 10^3. We compute the two complex zeros of Z closest to the real temperature axis. From a finite-size scaling analysis of these, we get the estimates $\nu = 0.6295(10)$ for the correlation-length exponent and phi = 52.2(7) for the angle between the first two zeros and the real u = e/sup -4//sup β/ axis.

46795 **Integral quantum Hall effect for nonspecialists.** Yennie, D.R. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853, Institute for Theoretical Physics, University of California, Santa Barbara, California 93106 and Stanford Linear Accelerator Center, Stanford, California 94305). *Reviews of Modern Physics;* **59**: No. 3, 781-824(Jul 1987).

An attempt is made to develop a description of the multielectron quantum state responsible for the integral quantum Hall effect. One goal is to provide intuitive support for the very powerful and general argument of Laughlin that the theoretical relationship is insensitive to complicating details in the interior of the sample. The model the author uses is somewhat more realistic than heretofore in that it is three dimensional, does not ignore the atomic structure of the bulk matter, and does not use an effective-mass approximation. In order to treat the problem quantum mechanically, the complete system, including circuitry external to the system of interest, is replaced by a model closed system consisting of a finite number of electrons. In this model, states with a finite Hall current and voltage are metastable against decay caused by interactions outside the model, such as those with bulk matter excitations. Such states describe the true situation well only in the conductivity plateaus; between plateaus, there would be current flow between the Hall voltage probes corresponding to decaying states. Experimental constraints replace this transverse current by a voltage drop along the direction of current flow. The interactions between the electrons are expressed in terms of a self-consistent potential which gives an independent-particle description as a starting point, and residual interactions which are treated by perturbation

theory. The self-consistent potential is found to be important in understanding the properties of the quantum state of the system, such as the existence of the plateaus in conductivity and how the electrons in the (effective) two-dimensional region come to equilibrium with the different Fermi levels in the voltage probes.

46796 **Microdiffraction with synchrotron radiation.** Ice, G.E. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 397-399(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

Storage ring sources are orders of magnitude brighter than the characteristic line of a rotating anode X-ray tube. This improved brightness allows X-ray diffraction with micron spatial resolution. We report on priliminary microdiffraction experiments using synchrotron radiation. In these experiments, synchrotron radiation beams were passed through specially prepared heavy metal pinholes to achieve probes as small as 10 μm. Both white beam and monochromatic beam techniques are discussed and the ralative merits are compared.

46797 **Dynamical image charge effects on convoy electron emission from solid surfaces.** Burgdoerfer, J. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 139-142(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

We analyze surface effects on the spectrum of convoy electrons emitted from solids in close association with fast highly chargerd ions. Three competing mechanisms have been identified: Deceleration by the surface barrier, acceleration by the repulsive dynamical image force, and energy loss due to surface plasmon generation. The resulting energy shift is significantly reduced compard to the value for the barrier height for a jellium surface. We also give estimates for the probability for nonadiabatic transitions between bound states due to the sudden perturbation by the potential step upon exit.

46798 **Exit charge state dependence of convoy electron production in heavy-ion-solid collisions.** Huelskoetter, H.P.; Burgdoerfer, J.; Sellin, I.A. (Tennessee Univ., Knoxville; Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 147-152(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

The dependence of the yield of convoy electrons emitted near the forward direction in collision involving fast ions and thin solid targets on the emergent projectile charge state is presented and described in terms of primary electron loss events in the solid. The data include a large array of projectiles, projectile energies and charge states, as well as targets ranging in thickness from the nonequilibrium well into the equilibrium thickness region. The description presented in constent with other experiment and theoretical results indicating that the convoy electron production is closely linked to the ELC process observed in binary ion-atom collisions, with the dominant contribution to the convoy yield stemming from excited states of the projectile.

46799 **Recent measurements of coherent transition radiation.** Moran, M.J. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 335-338(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

An extended series of experiments has been used to investigate transition radiation in the X-ray spectral region. The X-rays were generated at the Lawrence Livermore National Laboratory electron-positron linear accelerator by 54 MeV electrons traversing multiple thin-foil targets. The measured angular and spectral distributions have shown excellent agreement with calculated predicitions based on a simplified theoretical description of transition radiation. Recently, energy-resolved measurements of X-ray generation by targets consisting of multiple closely-spaced foils has clearly demonstrated the longitudinal coherence of transition radiation. This behavior might lead to a variety of applications such as tuneable narrow-band X-ray sources, measurement of X-ray dielectric constants, or particle beam diagnostics. These issues will be discussed and recent results will be presented.

46800 **Preparation and characterization of Langmuir and Langmuir Blodgett films.** Ketteerson, J.B.; Dutta, P. (Northwestern Univ., Evanston, IL). *Applied Physics Communications;* **7**: No. 1-2, 95(Mar-Jun 1987). Contract FG02-84ER45125.

Although monolayer Langmuir films at the air/water interface and multilayer Langmuir-Blodgett films deposited on various substrates have a time honored history, it is only recently that significant progress has been made in characterizing their structure. They will report on recent conventional and synchrotron x-ray studies, both at Northwestern University and elsewhere, on Langmuir and Langmuir Blodgett films. In particular the first in plane Langmuir Blodgett and monolayer Langmuir diffraction data have been obtained. Other experiments involving the elastic, and visco elastic response of Langmuir films, and the growth characteristics of Langmuir Blodgett multilayer films will also be discussed.

46801 **Electronic structure calculation of amorphous solid.** Ching, W.Y. (Univ. of Missouri, Kansas City). *Applied Physics Communications;* **7**: No. 1-2, 111(Mar-Jun 1987). Contract FG02-84ER45170.

Recent results on the successful application of first-principles method to the calculation of electronic structure of amorphous solids will be reviewed. The systems to be discussed include amorphous semiconductors, insulating glasses, metallic glasses and alloys of high structural complexity. Emphasis will be on the relationship between the atomic-scale short-range order in the structure and the local density of states of individual atom, and the characterization of localized/delocalized nature of electron states across the entire energy range in various amorphous solids.

46802 **Supercell total energy approach to transition metal alloy pair interactions.** Carlsson, A.E. (Washington Univ., St. Louis, MO). *Applied Physics Communications;* **7**: No. 1-2, 113(Mar-Jun 1987). Contract FG02-84ER45130.

A new method is described for obtaining effective pair interactions (EPI) in transition metal alloys from density-functional theory total energy calculations for supercell compounds. The calculated total energies are used to obtain explicit concentration-independent cluster interactions, through an inversion scheme. Using a truncated form for the higher-order interatomic correlation functions, the cluster interactions are resummed into concentration-dependent EPI. This method offers a treatment of electron-electron interactions that is more accurate than in existing methods such as the Generalized Perturbation Theory (GPT), although the long-ranged oscillations in the EPI are much more difficult to obtain. Furthermore, the method can be used with density-functional calculation which supersede the muffintin approximation, and can thus treat open crystal structures correctly. Results will be presented for Al-transition metal alloys, including Ni-Al. In Ni-Al the EPI is strongly concentration-dependent, with the ordering tendency much stronger at the Ni-rich end. The elastic strain energy contributes significantly to the EPI. The behavior of the EPI oscillates rapidly as a function of the transition metal d-band filling.

46803 **Resolution analyses for Moessbauer diffraction: resolved TDS profiles in silicon.** Crow, M.L.; Schupp, G.; Yelon, W.B.; Mullen, J.G.; Djedid, A. (Univ. of Missouri, Columbia). *Applied Physics Communications;* **7**: No. 1-2, 120(Mar-Jun 1987). Contract FG02-85ER45199;FG02-85ER45200.

The thermal diffuse scattering near the 444 reflection in silicon has been studied using high intensity Moessbauer radiation from the 46.68 keV transition in ^{183}W. The improvement in momentum resolution over earlier Moessbauer scattering studies has allowed observation of the directional dependence of the thermal

diffuse scattering. These measurements have given motivation for the first resolution function analyses appropriate for the Moessbauer diffraction. The measured momentum resolution half widths were 0.011 A^{-1} and 0.11 A^{-1} in the transverse and longitudinal directions, and the vertical resolution was 1.13 A^{-1}. The broad distribution of inelastic scattering seen is in agreement with calculations based on elastic constants and the resolution function analyses.

6561 Superconductivity

REFER ALSO TO CITATION(S) 45742, 45772, 45775, 45776, 45777, 45779, 45780, 45781, 45782, 45783, 45785, 45813, 46056, 46597

46804 (BNL—40013) Theory of the one- and two-dimensional electron gas. Emery, V.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 10p. (CONF-8705173—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012864.

From NATO ASI meeting on organic and inorganic low dimensional crystalline materials; Minorca-Beleares, Spain (3 May 1987).

Two topics are discussed: (1) the competition between 2k/sub F/ and 4k/sub F/ charge state waves in a one-dimensional electron gas and (2) a two-dimensional model of high T/sub c/ superconductivity in the oxides. (LSP)

46805 (IS-T—1218) Abrikosov vortex motion and elementary pinning force in a SNS [Superconductor-Normal metal-Superconductor] Josephson junction. Hyun, O.B. (Ames Lab., IA (USA)). Aug 1987. Contract W-7405-ENG-82. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87013607.

Procedures have been developed to determine the location of a single Abrikosov vortex in a Superconductor-Normal metal-Superconductor (SNS) Josephson junction and study its motion under the influence of a Lorentz force. A vortex in a SNS junction generates characteristic magnetic field inside the junction and this field, in turn, induces a specified phase across the junction. This phase caused by the vortex changes the critical current characteristics of the junction, that then can be used to locate the vortex inside the junction. A single vortex was successfully trapped in the junction by the field cooling process and the location was determined by the diffraction pattern. Motion of the vortex was induced by the transport current, I/sub p/, and the vortex was found to move in discrete jumps. By tracing the vortex after successive depinning events, many pinning centers could be identified. From the minimum depinning current, the elementary pinning force associated with an individual pinning site of the Pb-Bi (4 at. %) superconducting layer has been measured and found to be of order of 10^{-8} dyne (or 10^{-4} dyne/cm) at T/T/sub c/ = 0.95. The force is asymmetric and different from one pinning site to another. For the given SNS junction, the pinning force of a pinning center is dominant over all other forces associated with the vortex in the junction. In addition, from the experiment the temperature dependence of the pinning force is found to be f/sub p/ ~ (1 - T/T/sub c/)/sup 3/2/ near T/sub c/. There are two ingredients for the vortex depinning experiment. First, the N layer of the junction must be thick to reduce the field energy and dipole coupling force of the vortex. Secondly, vortex can be depinned at higher temperatures, at which depinning current is smaller than vortex nucleation current.

46806 (LA-UR—87-2537) On the rf surface resistance of the perovskite superconductors at 3 GHz. Hein, M.; Klein, N.; Mueller, F.M.; Mueller, G.; Piel, H.; Roeth, R.W.; Weingarten, W.; Willis, J.O. (Los Alamos National Lab., NM (USA); Wuppertal Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Physik der Bergischen). 1987. Contract W-7405-ENG-36. 3p. (CONF-870790—1). NTIS, PC A02. File Number DE87013170.

From 1. European workshop on high T/sub c/ superconductors and potential applications; Genova, Italy (1 Jul 1987).

The rf surface resistance is measured for $Y_1Ba_2Cu_3O_7$ samples fabricated in different laboratories by exposing them to the rf field of a niobium cavity at 3 GHz in a temperature range from 4.2 to 300 K. The rf surface resistance of the best sample decreases sharply at the transition temperature from typically 0.2 Ω at 100 K by more than two orders of magnitude. The residual losses measured at 4.2 K in the superconducting host cavity are strongly dependent on the purity of the sample. The observed dependence of the residual losses on the rf field level is attributed to the granular structure of the superconductor. Rf magnetic fields of up to 1800 A/m have been achieved in pulsed operation. This field corresponds to a surface current density of 1.3 . 10^6 A/cm^2. The low residual losses indicate that less than 1% of the conduction electrons of the perovskite superconductors remain unpaired.

46807 (SAND—87-2044C) Freestanding films of YBa_2Cu_3O/sub 6.9/. Ginley, D.S.; Kwak, J.F.; Mitchell, M.A.; Venturini, E.L.; Fu, W.; Baughman, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870873—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014156.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

Thick (20 to 300 μm) freestanding films of YBa_2Cu_3O/sub 6.9/ have been obtained through resintering powdered YBa_2Cu_3O/sub 6.9/ on fused silica followed by a subsequent oxygen anneal step. The transport and magnetic properties for these films are comparable to those for our best bulk ceramic samples.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 46137, 46390, 46425, 46432, 46477, 46482, 46572, 46580, 46622, 46625, 46626, 46628, 46630, 46637, 46638, 46785, 46845

46808 (DOE/ER/45189—T1) Theory of non-equilibrium growth: Progress report. Savit, R.; Sander, L.M. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 22 Jun 1987. Contract FG02-85ER45189. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012009.

The bulk of the new work described arises naturally from the studies begun under the present grant, namely the investigation of the subtle interplay of symmetry and disorder in the formation of non-equilibrium objects. The major thrust of the research has been the description of how growth processes can in some cases give rise to macroscopic patterns subtly influenced by microscopic dynamics, and in other cases to scale-invariant morphologies. Such processes are clearly of great intellectual interest, and correspond to the way in which many natural objects are formed, both in the context of physics and of biology. The first several sections of new work proposed are about ballistic aggregation and fractal aggregation. Next, are the studies in the new subject of multifractals. The following section describes a continuation of our exploration of growth oscillations. Following that, is described an ongoing study of pattern formation, and a series of new studies growing out of our current work on microscopic solvability. Included here are two topics in which the dynamics of diffuse interfaces must be considered.

46809 (IC—86/294) Statistical mechanics of a one-component fluid of charged hard rods in 1D. Vericat, F.; Blum, L. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703058.

The statistical mechanics of a classical one component system of charged hard rods in a neutralizing background is investigated in 1D stressing on the effects of the hard core interactions over the thermodynamic and the structure of the system. The crystalline status of the system at all temperatures and densities and the absence of phase transitions is shown by extending previous results of Baxter and Kunz on the one-component plasma of point particles. Explicit expressions for the thermodynamic functions and the one-particle correlation function are given in the limits of small and strong couplings. 6 refs, 2 figs.

46810 (IC—86/296) On oscillation of a kind of integro-differential equation with delay. Zhang, Binggen. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703059.

A sufficient condition is obtained for the oscillation of a kind of integro-differential equation with delay. 3 refs.

46811 **(IC—86/307) Oscillatory and nonoscillatory properties of first order differential equations with piecewise constant deviating arguments.** Zhang, B.G.; Parhi, N. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703061.

In this paper, sufficient conditions have been obtained for oscillation and non-oscillation of solutions of first order differential equations with piecewise constant deviating arguments. These equations occur in mathematical models of certain biomedical problems. 6 refs.

46812 **(IC—86/311) Laplace operator on a bundle with a Sasaki metric.** Abed, S.H. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703063.

Differential operators of various kinds have always been ominipresent in differential geometry. The role of some of them is prominent and decisive in many geometric structures carried by a differentiable manifold. It is the classical concept of covariant derivation that is formulized and generalized in the theory of connections. The building of cohomology theory rests upon the notion of exterior derivative and upon those associated to it via some additional structures (a metric, for example) on the underlying manifold: the codifferential δ, the Laplace operator, etc. The objective of my research was to investigate in a systematic manner some of these operators in the context of Finsler bundles. In the present paper we give the answer to an important question: How can one calculate the Laplace operator on a bundle with a Sasaki metric? 3 refs.

46813 **(IC—86/316) Is the compactified vacuum semiclassically unstable.** Maeda, Keiichi. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703067.

It is shown, by applying the positive energy theorem, that the present vacuum (M/sup 4/xK/sup D/) in some higher-dimensional theories (e.g. the Candelas-Weinberg model) is stable against decay by quantum tunnelling without change of topology. Frieman and Kolb have found a quantum tunnelling instability of the present vacuum in the same models. But they did not take into account the gravitational effect, which is important and prevents the universe from decaying into the higher-dimensional de Sitter phase. 17 refs, 1 fig.

46814 **(IC—86/330) Quantum electrodynamics based on self-energy: Spontaneous emission in cavities.** Barut, A.O.; Dowling, J.P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703071.

We extend a previously developed formulation of QED based on self-energy to include the effect of perfectly conducting boundaries on spontaneous emission. The method is quite general and applicable to any quantum system and many boundary geometries. In particular, we compute the spontaneous emission rate of an atom near a conducting plate, inside a spherical cavity and between parallel plates, we give general formulas and predict both enhanced and inhibited rates, in agreement with recent experiments. 36 refs, 4 figs.

46815 **(IC—86/331) Quantum mechanics with spontaneous localization and the quantum theory of measurement.** Benatti, F.; Ghirardi, G.C.; Rimini, A.; Weber, T. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703072.

Recently a modification of quantum dynamics allowing a unified description of microscopic and macroscopic systems has been introduced. We investigate here the consequences of this approach for the measurement problem. We show that in this way one gets a consistent and objective solution of the problem of the wave packet reduction. 11 refs, 2 figs.

46816 **(IC—86/335) Direction dependent connections of complex manifolds and their submanifolds.** Rastogi, S.C. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703073.

By using the method of calculus of variations in 1967, Rund introduced a generalised metric on complex manifold. He also defined direction dependent connections on such manifolds. Later on in 1972, Rund introduced general direction dependent connections on complex manifolds. Based on these connection coefficients he defined curvature and torsion tensors and obtained some interesting results in case of metric connections. The aim of this paper is to study submanifolds of such complex manifolds. In this paper I have defined induced and intrinsic connections and curvature tensors based on them. Besides this equations analogous to Gauss-Codazzi have been obtained for both induced and intrinsic connections. In the end some applications of these results are given by studying submanifolds of complex manifolds of isotropic curvature. 2 refs.

46817 **(IC—86/347) On the theory of the Michelson-Morley experiment in the Earth's gravitational field.** Zhang, Y.Z. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703077.

In this paper we discuss further the expected results for a Michelson-Morley-type experiment with one of the arms in the vertical direction in the Earth's gravitational field. It is shown from a dimensional analysis that the expected effect, in the case of the arms having length of the order of 1m, is the order of ml/R. This means that the expected fringe shift, if wavelength of light is 1μm, is the order of 10/sup -10/ when the interferometer is rotated through 90. 7 refs, 2 figs.

46818 **(IC—86/359) On the interaction of a planar metal surface with a charge and with a molecule.** Mukhopadhyay, G. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87703083.

We present a dynamic response approach to the interaction of a planar metal surface described by the semi-infinite jellium with a charge and with a molecule. In particular, we express the dynamic image potential of a moving charge as well as the van der Waals interaction energy of a neutral atom or molecule (static as well as moving) in terms of a form factor $F(k,\omega)$. This form factor F is not known accurately for general k and ω, and we discuss various formulas for different approximate forms for F. We show that the weakening (or saturation) of the interactions at distances close to the surface is determined mainly by the large k behaviour of F and therefore we emphasize the need for an accurate numerical determination of this form factor for large k-regime. 72 refs, 2 figs.

46819 **(IC—86/363) Coherent and incoherent exciton motion in the framework of the continuous time random walk.** Barvik, I.; Szocs, V. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703084.

We derive the hopping time distribution function of the continuous time random walk theory starting from the microscopic form of memory functions for one-dimensional exciton motion. 11 refs, 1 fig.

46820 **(IC—86/366) Geometrization of Planck length in composite gravity and supergravity.** Lukierski, J.; Mozrzymas, M.; Rytel, L. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703085.

The Volkov-Akulov (VA) standard action can be treated as composite cosmological term, with composite vierbein described by massless Goldstone fermions. By considering massive Goldstone fermions one can relate classically VA and composite Einstein gravity actions, provided the mass of Goldstone fermions, Planck mass and the SSB scale are related. It is also shown that the action of N=1 and N=2 supergravity with composite gauge fields can be written respectively module topological terms as N=1 and N=2 composite supersymmetric cosmological terms. 17 refs.

46821 (IC—86/379) Finite-dimensional matrix representation of the differential operator, determinental form and zeros of special functions. Santhanam, T.S.; Jagannathan, R. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703091.

Finite dimensional matrix representations of differential operators are discussed. The determinental form of polynomials is used to relate their zeros to the eigenvalues of Jacobi's tridiagonal matrix for the case of special functions. The distribution of these zeros is analyzed. 9 refs.

46822 (IC—86/388) Riemann surfaces and string theory. Gava, E. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703093.

After some mathematical background on Riemann surfaces and moduli space, the bosonic string partition function is analyzed and the physical meaning of its divergences is discussed. Selberg's and analytic expressions are compared. 40 refs.

46823 (IC—86/392) New class of spherically symmetric interior solution with cosmological constant Λ. Xu Chongming; Wu Xuejun; Huang Zhun. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703095.

In this paper, a new class of spherically symmetric interior solution with cosmological constant Λ is obtained, to which Florides' solution is extended. As a special case, the metric in uniform proper density is discussed. The Robson junction condition is also extended to the case with Λ, which is a set of necessary and sufficient condition for a spherically symmetric metric to join smoothly onto the vacuum metric at a nonnull boundary surface. The new solution satisfies the extended Robson condition. 13 refs.

46824 (IC—87/1) Classical model of the Dirac electron in curved space. Barut, A.O.; Pavsic, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703100.

The action for the classical model of the electron exhibiting Zitterbewegung is generalized to curved space by introducing a spin connection. The dynamical equations and the symplectic structure are given for several different choices of the variables. In particular, we obtain the equation of motion for spin and compare it with the Papapetrou equation. 18 refs.

46825 (KFKI—1986-79/A) Exact solution for particle trajectories in modified quantum mechanics. Diosi, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Oct 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703118.

Considering a simple quantum master equation for a free particle it is proved that after a given period of relaxation the solutions can be interpreted exactly in terms of uniform localized wave packets whose centers imitate classical trajectories. 13 refs.

46826 (LA—10878) Primer on coupling collective electronic oscillations to nuclei. Solem, J.C.; Biedenharn, L.C. Jr. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012701.

On the basis of simple heuristic models, we show that atomic electrons can amplify fields observed at the nucleus, generate harmonics, and drive higher multipolarities. Considered is a model with the nucleus at the focus of a uniformly charged ellipsoid. It amplifies an oscillating external electric field and produces an oscillating electric-field gradient but no higher derivatives. The electric field has only odd harmonics and the electric-field gradient has only even harmonics. There is an optimum intensity for driving each harmonic. Commented on is the relevance of these results to the U^{235} experiment and to the gamma-ray laser.

46827 (LA-UR—87-2315) Different ways of looking at the electromagnetic vacuum. Milonni, P.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 33p. (CONF-870785—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013150.

From Adriatico Research conference on vacuum in nonrelativistic matter-radiation systems; Trieste, Italy (1 Jul 1987).

Some thoughts on the electromagnetic vacuum are presented in connection with the vacuum and source fields as alternative physical bases for understanding spontaneous emission, the Lamb shift, Casimir effects, van der Waals forces, and the "thermalization" of vacuum fluctuations for a uniformly accelerated observer.

46828 (LA-UR—87-2386) Antiprotons are another matter. Hynes, M.V. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 20p. (CONF-8706176—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013159.

From Workshop and symposium on the physics of low energy, stored, and trapped particles; Stockholm, Sweden (14 Jun 1987).

Theories of gravity abound, whereas experiments in gravity are few in number. An important experiment in gravity that has not been performed is the measurement of the gravitational acceleration of antimatter. Although there have been attempts to infer these properties from those of normal matter, none of these theoretical arguments are compelling. Modern theories of gravity that attempt to unify gravity with the other forces of nature predict that in principle antimatter can fall differently than normal matter in the Earth's field. Some of these supergravity theories predict that antimatter will fall faster, and that normal matter will fall with a small Baryon-number dependance in the earth's field. All of these predictions violate the Weak Equivalence Principle, a cornerstone of General Relativity, but are consistent with CPT conservation. In our approved experiment at LEAR (PS-200) we will test the Weak Equivalence Principle for antimatter by measuring the gravitational acceleration of the antiproton. Through a series of deceleration stages, antiprotons from LEAR will be lowered in energy to ~4 Kelvin at which energy the gravitational effect will be measureable. The measurement will employ the time-of-flight technique wherein the antiprotons are released vertically in a drift tube. The spectrum of time-of-flight measurements can be used to extract the gravitational acceleration experienced by the particles. The system will be calibrated using H^- ions which simulates the electromagnetic behavior of the antiproton, yet is a baryon to ~0.1%. To extract the gravitational acceleration of the antiproton relative to the H^- ion with a statistical precision of 1% will require the release of ~10^6 to 10^7 particles.

46829 (LBL—23483) A realistic model for quantum theory with a locality property. Eberhard, P.H. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87012887.

A model reproducing the predictions of relativistic quantum theory to any desired degree of accuracy is described in this paper. It involves quantities that are independent of the observer's knowledge, and therefore can be called real, and which are defined at each point in space, and therefore can be called local in a rudimentary sense. It involves faster-than-light, but not instantaneous, action at distance.

46830 (N—87-25140) Role and behavior of spin in gravitational physics. Final report, 15 May 1986-15 May 1987. Ray, J.R. (Clemson Univ., SC (USA)). Jul 1987. 6p. (NASA-CR—180654; NAS—1.26:180654). NTIS, PC A02/MF A01.

A self-consistent method of introducing spin into any Lagrangian based theory of gravitation was developed. The metric variation of the Lagrangian in the theory leads to an improved energy-momentum tensor which represents the source term in the gravitational field equations. The goal of the research is the construction of a theory general enough to be used to investigate spin effects in astrophysical objects and cosmology, and also to serve as a basis for discussion of the theoretical ideas tested by the NASA

Gyroscope Experiment (aboard Gravity Probe B). Specific accomplishments in the following areas are summarized: the inclusion of electromagnetism into the variational principle for spinning matter, formulation of a self-consistent theory for the case of a fluid in which particle production processes occur, and the derivation of the Raychaudhuri equation in the case of spinning matter.

46831 **(UWThPh—1987-06) Holistic aspects of quantum mechanics.** Pietschmann, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703129.

Aspects of quantum mechanics irreconcilable with classical physics are outlined. Quantum mechanics started with a negative statement about reality, namely: it is impossible to determine momentum and position of a particle simultaneously. Meanwhile it has generated an impressive body of predictions which can be tested and have been confirmed by suitable experiments. As a consequence a naive, local, materialistic concept of reality must be abolished and a novel approach, the holistic is introduced. This is illustrated by some examples e.g. the Pauli exclusion principle for electrons, the electron capture decay of /sup 135/La as a model of the wavefunction reduction, the Bohr radius of the atom, electron localisation in the atom. An example from the quantum field theory is the calculation of magnetic moments of electron and muon where a particle cannot be considered separately and all other particles must be taken into account. (G.Q.).

46832 **(UWThPh—1987-12) Dynamical entropy of quasi-free automorphisms.** Narnhofer, H.; Thirring, W. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703134.

The dynamical entropy of quasifree automorphisms and quasifree states is calculated and shown to be the entropy of the shift created by the group velocity. Some continuity properties are proved.

46833 **Baker—Campbell—Hausdorff relations for the super-Poincare group.** Kostelecky, V.A.; Truax, D.R. (Department of Physics, Indiana University, Bloomington, Indiana 47405 and Theory Division, CERN, 1211 Geneve 23, Switzerland). *Journal of Mathematical Physics (New York);* **28**: No. 10, 2480-2487(Oct 1987).

Baker—Campbell—Hausdorff relations are obtained for the connected supergroup associated with the super-Poincare algebra iosp(1chemical bond4).

46834 **Critical behavior of a new class of statistical-mechanical models with continuous variables and discretely valued interactions.** Lee, I.; Shrock, R.E. (Department of Physics, Ohio State University, Columbus, Ohio 43210). *Physical Review [Section] B: Condensed Matter;* **36**: No. 7, 3712-3715(1 Sep 1987).

We formulate a new type of classical statistical-mechanical models with continuous variables but discretely valued interactions, and determine, via exact solutions and high-temperature series expansions, the critical behavior of several such models.

46835 **Path-integral derivation of the complex ABCD Huygens integral.** Wright, E.M.; Garrison, J.C. (Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). *Journal of the Optical Society of America A: Optics and Image Science;* **4**: No. 9, 1751-1755(Sep 1987).

The Huygens integral, or Green's function, for paraxial beam propagation in a generalized lenslike medium is derived as a Feynman path integral involving a summation over real rays. This formulation provides a physically intuitive understanding of the structure of the Green's function. The path integral is evaluated by introducing in a consistent manner the notion of complex rays, and the familiar result for the Huygens integral in terms of the complex ABCD matrix of the medium is obtained.

46836 **Cary, Rusu, and Skodje reply.** Cary, J.R.; Rusu, P.; Skodje, R.T. (University of Colorado, Boulder, Colorado 80309). *Physical Review Letters;* **59**: No. 8, 943-943(24 Aug 1987).

A reply to he comment on quantum effects in a macroscopic system is prsented. (AIP)

46837 **Predicting chaotic time series.** Farmer, J.D.; Sidorowich, J.J. (Theoretical Division and Center for Nonlinear Studies, MS B258, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **59**: No. 8, 845-848(24 Aug 1987).

We present a forecasting technique for chaotic data. After embedding a time series in a state space using delay coordinates, we "learn" the induced nonlinear mapping using local approximation. This allows us to make short-term predictions of the future behavior of a time series, using information based only on past values. We present an error estimate for this technique, and demonstrate its effectiveness by applying it to several examples, including data from the Mackey-Glass delay differential equation, Rayleigh-Benard convection, and Taylor-Couette flow.

46838 **Geometrical-integrability constraints and equations of motion in four plus extended super spaces.** Chau, L.L. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 394-397 of Proceedings of the XXIII international conference on high energy physics. Loken, S.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-860701—).

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

It is pointed out that many equations of motion in physics, including gravitational and Yang-Mills equations, have a common origin: i.e. they are the results of certain geometrical integrability conditions. These integrability conditions lead to linear systems and conservation laws that are important in integrating these equations of motion.

46839 **Cartan determinants, LIE algebra extensions, and the exceptional group series.** Capps, R.H. (Purdue Univ., West Lafayette, IN 47907). pp 273-282 of Rationale of beings: Recent developments in particle, nuclear and general physics. Ishikawa, K.; Kawazoe, Y.; Matsuzaki, H.; Takahashi, K. Teaneck, NJ; World Scientific Pub. Co. (1986).

In this note the author utilizes the determinant of the generalized Cartan matrix for candidate Dynkin systems for two purposes. The first is to provide an uncomplicated criterion for classifying candidate one-root extensions of diagrams for semisimple Lie algebras. The second is to help determine some important properties of related Lie algebras and their representations.

46840 **Solutions of discrete mechanics near the continuum limit.** Lee, T.D. (Columbia Univ., New York, NY 10027). pp 265-272 of Rationale of beings: Recent developments in particle, nuclear and general physics. Ishikawa, K.; Kawazoe, Y.; Matsuzaki, H.; Takahashi, K. Teaneck, NJ; World Scientific Pub. Co. (1976).

The time-distribution in classical discrete mechanics near the continuum limit is given for a non-relativistic particle moving in an arbitrary potential.

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REFER ALSO TO CITATION(S) 45689, 46419, 46449, 46920, 46922, 46941, 46986, 46996

46841 **(CONF-870788—1-Summ.) Heavy-particle collisions in the plasma edge.** Phaneuf, R.A.; Hunter, H.T.; Barnett, C.F. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012928.

From Meeting on atomic and molecular data for plasma edge studies; Vienna, Austria (8 Jul 1987).

Available cross-section data for heavy-particle collision processes which play important roles in the edge plasma of magnetically-confined fusion devices are surveyed and reviewed. The species considered include H, H_2, He, C, O, Fe, and their ions. The most important heavy-particle collision processes occurring in the edge plasma are charge-exchange reactions. Excitation and dissociation processes are also considered. Emphasis is given to relative collision velocities corresponding to plasma ion temperatures in the 1 to 200 eV range. Evaluated or recommended data are presented where possible along with their estimated uncertainties, and gaps in the data base are indicated.

46842 **(CONF-8706119—2) Problems in modeling TF ripple loss of fast alphas from a tokamak reactor.** Hively, L.M. (Oak Ridge National Lab., TN (USA)). 15 Jun 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011677.

From Workshop on alpha particle effects in ETR; Washington, DC, USA (15 Jun 1987).

The report consists of viewgraphs. Topics covered are (1) basic ripple processes, (2) simulations of combined processes, (3) modeling issues, (4) new physics problems, and (5) consequences for ETR/ITER. (WRF)

46843 **(CTH-IEFT/PP—1986-05) Fluid analysis of electromagentic ballooning modes in a fully toroidal description.** Andersson, P.; Weiland, J. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752426.

A comparatively complete two fluid description of collisionless electromagnetic ballooning modes has been derived. Using an unexpanded ion density response it has been shown that a necessary and sufficient condition for an instability below the MHD/BETA/ limit is the presence of an ion temperature gradient exceeding a threshold. The cause of this instability has been identified and an analytical dispersion relation is given.

46844 **(CTH-IEFT/PP—1986-09) Time evolution of the velocity distribution of neutral beam injections heated by ICRH in a two component plasma.** Andersson, D.; Eriksson, L.G.; Lisak, M. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752427.

The time of the distribution function of the beam injected particles in the presence of ICRH in a two component plasma is determined. Consideration is restricted to the time development during two complementary time periods: (i) the early time period i.e. $0 < t << /tav/sb(s)$, and (ii) the quasi-steady-state, i.e. $t > /tav/sb(s)$, where /tav/sb(s) is the slowing-down time for beam ion-electron collisions. Explicit analytical solutions are obtained for anisotropic as well as isotropic beam injection.

46845 **(DOE/ER/52127—14) A model for electron currents near a field null.** Stark, R.A.; Miley, G.H. (Naval Surface Weapons Center, Silver Spring, MD (USA); Illinois Univ., Urbana (USA)). 1987. Contract FG02-86ER52127. 21p. (CONF-870631—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013014.

From 8. US symposium on compact toroid research and the 9. US/Japan workshop on compact toroids; College Park, MD, USA (4 Jun 1987).

The fluid approximation is invalid near a field null, since the local electron orbit size and the magnetic scale length are comparable. To model the electron currents in this region we propose a single equation of motion describing the bulk electron dynamics. The equation applies to the plasma within one thermal orbit size of the null. The region is treated as unmagnetized; electrons are accelerated by the inductive electric field and drag on ions; damping is provided by viscosity due to electrons and collisions with ions. Through variational calculations and a particle tracking code for electrons, the size of the terms in the equation of motion have been estimated. The resulting equation of motion combines with Faraday's Law to produce a governing equation which implicitly contains the self inductive field of the electrons. This governing equation predicts that viscosity prevents complete cancellation of the ion current density by the electrons in the null region. Thus electron dynamics near the field null should not prevent the formation and deepening of field reversal using neutral-beam injection.

46846 **(DOE/ER/53192—5) Magnetic surface mapping with highly transparent screens on the Auburn Torsatron.** Hartwell, G.J.; Gandy, R.F.; Henderson, M.A.; Hanson, J.D.; Swanson, D.G.; Bush, C.J.; Colchin, R.J.; England, A.C.; Lee, D.K. (Auburn Univ., AL (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA)). [1987]. Contract FG05-85ER53192. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013454.

In stellarator-type magnetic confinement devices (of which the torsatron is one), the magnetic field is produced entirely by external, current-carrying coils. Two methods for mapping magnetic surfaces in the Auburn Torsatron were tested and compared, both of which involve the use of highly transparent screens. The first method consists of coating the screen with a phosphor that emits light when struck by electrons emitted by an electron gun. A pattern representative of a magnetic surface is formed on the screen, and this pattern is recorded photographically. The second method uses an uncoated screen to collect electrons emitted from an emissive probe, which is scanned over a poloidal cross section of the torus. Under certain conditions, the collected current is a constant over a particular magnetic surface so that a contour plot of the current versus position is equivalent to a plot of the magnetic surfaces. Parametric studies of the two methods are presented, and the effectiveness of each technique is discussed.

46847 **(DOE/ER/53220—T1) Plasma theory and simulation: Quarterly progress report Nos. 1 and 2, January 1, 1986-June 30, 1986.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 30 Jun 1986. Contract FG03-86ER53220. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013285.

This quarterly report deals with General Plasma Theory and Simulation. Computer simulation of bounded plasma systems, with external circuits, is discussed in considerable detail. Artificial cooling of trapped electrons in bounded simulations was observed and is now attributed to noiseless injection; the cooling does not occur if random injection is used. This report also deals with Plasma-Wall Physics and Simulation. The collector and source sheaths at the boundaries of warm plasma are treated in detail, including ion reflection and secondary electron emission at the collector. The Kelvin-Helmholtz instability is observed in a self-consistent magnetized sheath, producing long-lived vortices which increase the particle transport to the wall dramatically.

46848 **(DOE/ER/53222—95) Second regime tokamak operation at large aspect ratio.** Bhattacharjee, A.; Iacono, R.; Marshall, T.C.; Mauel, M.E.; Navratil, G.A.; Paranicas, C.; Sabbagh, S.A.; Sen, A.K.; Van Dam, J.W.; Wang, X.H. (Columbia Univ., New York (USA). Plasma Physics Lab.). Jun 1987. Contract FG02-86ER53222;FG02-86ER53236. 199p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87013855.

The equilibrium, stability, and transport properties of large aspect ratio tokamaks operating at the second stability regime are described theoretically using numerical and analytical techniques. It has been shown that, at large aspect ratio, significant current profile control is possible with relatively modest amounts of neutral beam current drive, and the power needed to access and maintain the second regime operation is calculated to be about 3 MW using the results of an integrated 1.5D transport and stability code. An example second regime experiment has been described and the results are presented of extensive calculations illustrating several possible operating scenarios, external and internal model stability boundaries, and the experimental features needed to evaluate and test the high beta tokamak theories. The theory which describes the stabilizing effect of energetic particles during high beta operation was extended to finite aspect ratio. A key technical problem for application of this technique appears to be caused by ripple transport.

Plasma rotation effects are found to be generally destabilizing and several other schemes for improved access to the second stability regime are discussed including ponderomotive stabilization of the plasma edge region and active feedback control.

46849 **(DOE/ER/53223—T1) [Plasma properties: Annual report].** (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). 1987. Contract FG02-86ER53223. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013662.

The Magneto-Fluid Dynamics Division of the Courant Institute is engaged in a broad program of basic research in the theoretical aspects of plasma physics and magneto-fluid dynamics with emphasis on those areas which are relevant to the fusion energy program. The total research program in the division includes efforts in the areas of plasma containment, stability, equilibrium, transport, wave propagation (including shock waves), heating, orbit theory, as well as numerical experiments and the development of practical numerical methods in all plasma problems. Applications are made to the following project areas: Tokamaks, Mirrors, Stellarators, and Alternate Concepts. Developments include the whole spectrum of models from macroscopic MHD and guiding center to Vlasov, drift kinetic Fokker-Planck, and Boltzmann. This document describes research completed as well as programs in progress.

46850 **(DOE/ET/53088—283) Theory of trapped-particle-induced resistive fluid turbulence.** Biglari, H.; Diamond, P.H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). May 1987. Contract FG05-80ET53088. 29p. (IFSR—283). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014422.

A theory of anomalous electron heat transport, evolving from trapped-particle-induced resistive interchange modes, is proposed. These latter are a new branch of the resistive interchange-ballooning family of instabilities, destabilized when the pressure carried by the unfavorably-drifting trapped particles is sufficiently large to overcome stabilizing contributions coming from favorable average curvature. Expressions for the turbulent heat diffusivity and anomalous electron thermal conductivity at saturation are derived for two regimes of trapped particle energy: (1) a moderately-energetic regime, which is "fluid-like" in the sense that the unstable mode grows faster than the time that it takes for particles in this energy range to precess once around the torus; and (2) a highly-energetic regime, where the trapped species has sufficiently high energy as to be able to resonantly interact with the mode. Unlike previous theories of anomalous transport, the estimates of diffusion and transport obtained here are self-consistent, since the trapped particles do not "see" the magnetic flutter due to their rapid bounce motion. The theory is valid for moderate electron-temperature, high ion-temperature (auxiliary-heated) plasmas, and as such, is relevant for present and future-generation experimental fusion devices.

46851 **(DOE/ET/53088—287) Momentum and thermal transport in neutral-beam-heated tokamaks.** Mattor, N.; Diamond, P.H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1987. Contract FG05-80ET53088. 28p. (IFSR—287). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014423.

The report explores the relation between momentum and thermal transport in neutral-beam-heated tokamaks with subsonic toroidal rotation velocity. A theory of diffusive momentum transport driven by ion-temperature-gradient-driven turbulence (eta/sub i/-turbulence) is presented. In addition, the level of eta/sub i/-turbulence is enhanced by radially sheared toroidal rotation. The resulting ion shear viscosity chi/sub phi/ is found. The associated ion thermal diffusivity, chi/sub i/, is identical to chi/sub phi/. Thus, a scenario based on velocity-shear-enhanced eta/sub i/-turbulence is consistent with the experimentally observed relationship between thermal and momentum confinement.

46852 **(DOE/ET/53088—290) Neoclassical electron heat conduction in tokamaks performed by the ions.** Ware, A.A. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1987. Contract FG05-80ET53088. 8p. (IFSR—290). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014002.

The increment to neoclassical ion heat conduction caused by electron collisions is shown to act like electron heat conduction since the energy is taken from and given back to the electrons at each diffusion step length. It can exceed electron neoclassical heat conduction by an order of magnitude.

46853 **(DOE/ET/53088—292) Thermally driven convective cells and tokamak edge turbulence.** Thayer, D.R.; Diamond, P.H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1987. Contract FG05-80ET53088. 44p. (IFSR—292). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014424.

A unified theory for the dynamics of thermally driven convective cell turbulence is presented. The cells are excited by the combined effects of radiative cooling and resistivity gradient drive. The model also includes impurity dynamics. Parallel thermal and impurity flows enhanced by turbulent radial diffusion regulate and saturate overlapping cells, even in regimes dominated by thermal instability. Transport coefficients and fluctuation levels characteristic of the saturated turbulence are calculated. It is found that the impurity radiation increases transport coefficients for high density plasmas, while the parallel conduction damping, elevated by radial diffusion, in turn quenches the thermal instability. The enhancement due to radiative cooling provides a resolution to the dilemma of explaining the experimental observation that potential fluctuations exceed density fluctuations in the edge plasma (e PHI/T/sub e/ > n/n_0).

46854 **(DOE/ET/53088—293) New directions in Vlasov plasma turbulence and anomalous transport.** Terry, P.W.; Diamond, P.H.; Hahm, T.S. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1987. Contract FG05-80ET53088. 26p. (CONF-8704170—2; IFSR—293). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014425.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

The nature and role of nonwavelike incoherent fluctuations in Vlasov plasma turbulence and transport are considered. In particular, electrostatic drift holes, which are localized, self-binding incoherent fluctuations giving large negative skewness, are described in detail. Both the three dimensional structure and dynamics of drift holes are discussed. The important role of incoherent fluctuations in plasma transport is underscored with an example, that of transport in drift-Alfven turbulence.

46855 **(GA-A—18912) Recent improvements to the GATO MHD [magnetohydrodynamics] stability package.** Turnbull, A.D.; Helton, F.J.; Greene, J.M.; Chu, M.S. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1987. Contract AC03-84ER53158. 8p. (CONF-870947—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013450.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

Recent interest in highly elongated and strongly shaped tokamaks has necessitated a number of modifications to the GATO/GAEQ equilibrium and stability package. In particular, the GATO mapping routines have been rewritten to properly resolve the highly elongated ($\kappa > 5$) flux surfaces that often arise near the magnetic axis when the separatrix elongation exceeds two. A more accurate treatment of logarithmic divergences in the Green's function vacuum representation is also described.

46856 **(IAE—4221/7) Study on the characteristics of CO/sub 2/-laser for scattering diagnostics at tokamak devices.** Zhukovskij, V.G.; Rtishchev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703050.

The purpose of the study is the construction of possibly simple-design single-frequency monopulse CO/sub 2/-laser for scattering diagnostics at tokamak devices. Timing and frequency characteristics of radiation are investigated. For obtaining narrow (— 100 ns) radiation pulse with maximum energy the mixtures with low nitrogen content have been selected. The selection of transverse modes has been attained applying the unstable resonator.

Two methods of longitudinal modes selection - fine electrochemical adjustment of the resonator length and injection of continuous CO/ sub 2/-laser radiation are considered. In both cases the bandwidth of laser generation — 100 MHz with pulse energy — 7 J is obtained. Both methods of narrowing the generation band can be realized in pulse CO/sub 2/-laser. 22 refs.; 5 figs.

46857 (IAE—4228/6) Collision integral for inhomogeneous plasma in a magnetic field effecting on particle collisions. Trushin, S.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87703051.

The collision integral of kinetic equation for the case when the Larmor radius of particles is less than the Debye radius is obtained. Though this problem has been considered in a number of studies main attention has been given usually to the effect of variation of Coulomb logarithm which is valid also for homogeneous plasma. In the present study a series of new components containing derived coordinate-distribution functions which under certain conditions can probably lead to variation of known coefficients of diffusion and thermal conductivity of plasma is obtained. The causes of difference of some results of other authors, for example, for electron flux due to transverse to the field ion motion are considered as well. 11 refs.

46858 (IC—86/327) Study of ionization equilibrium of high temperature and low density plasma. Alam, B. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87703070.

The works on ionization equilibrium available in the literature are briefly reviewed. Fractional ion abundance of coronal ions of C, N, O, Ne, Mg, Al, Si, S, Ca and Fe are calculated by using a new formula for the rate coefficient of dielectric recombination given by Alam and Ansari (1985). On comparison it is found that our results for highly charged ions are nearly in agreement with those of others. But for ions of low ionization stages our results differ substantially. 38 refs, 4 figs, 10 tabs.

46859 (ORNL/TM—10223) ICRF heating in a straight, helically symmetric stellarator. Jaeger, E.F.; Weitzner, H.; Batchelor, D.B. (Oak Ridge National Lab., TN (USA)). Jul 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013364.

Experimental observations of direct ion cyclotron resonant frequency (ICRF) heating at fundamental ion cyclotron resonance on the L-2 stellarator have stimulated interest in the theoretical basis for such heating. In this paper, global solutions for the ICRF wave fields in a helically symmetric, straight stellarator are calculated in the cold plasma limit. The component of the wave electric field parallel to B-vector is assumed zero. Helical symmetry allows Fourier decomposition in the longitudinal (z) direction. The two remaining partial differential equations in tau and phi identical to Θ - hz (h is the helical pitch) are solved by finite differencing. Energy absorption and antenna impedance are calculated from an ad hoc collision model. Results for parameters typical of the L-2 and Advanced Toroidal Facility (ATF) stellarators show that direct resonant absorption of the fundamental ion cyclotron resonance occurs mainly near the plasma edge. The magnitude of the absorption is about half that for minority heating at the two-ion hybrid resonance.

46860 (ORNL/TM—10374) Studies of a flexible heliac configuration. Hender, T.C.; Cantrell, J.L.; Harris, J.H.; Carreras, B.A.; Lynch, V.E.; Lyon, J.F.; Fabregas, J.A.; Guasp, J.; Lopez-Fraguas, A.; Navarro, A.P. (Junta de Energia Nuclear, Madrid (Spain). Div. de Fusion). Jul 1987. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013367.

This paper documents a detailed study of the Flexible Heliac configuration. The remarkable flexibility of this device - which allows variation of the rotational transform, shear, and magnetic well depth over a relatively wide range - is described. Engineering considerations of error fields, finite cross-section conductors, and plasma coil clearances are also discussed.

46861 (ORNL/TM—10382) Volt-second consumption in tokamaks with sawtooth activity. Houlberg, W.A. (Oak Ridge National Lab., TN (USA)). 1987. 31p. NTIS, PC A03/MF A01. File Number DE87013366.

The effects of sawtooth activity on the poloidal magnetic flux and energy balances in tokamak plasmas on a diffusive timescale are evaluated through the application of conservation principles to Maxwell's equations. Poloidal magnetic flux (volt-second) consumption can be partitioned into internal and dissipative components by two methods: the 'axial method' based on a magnetic flux balance and the 'Poynting method' based on a magnetic energy balance. Both require additional terms that specifically account for the poloidal flux and magnetic energy changes during magnetic reconnection derived from analysis on a magnetohydrodynamic (MHD) timescale. In experimental analyses these terms are absorbed in the inferred resistive dissipation, while in predictive analyses thay must be evaluated directly. The dissipation of poloidal flux by sawtooth activity can exceed the normal resistive dissipation when the axial method of accounting is used.

46862 (PFC/IR—87-1) Massachusetts Institute of Technology Plasma Fusion Center: 1986-1987 Report to the President. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Jul 1987. Contract AC02-78ET51013. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013518.

During the past year, technical progress has been made in all Plasma Fusion Center (PFC) research programs. The Plasma Fusion Center is recognized as one of the leading university research laboratories in the physics and engineering aspects of magnetic confinement fusion. Its research programs have produced significant results on four fronts: (a) the basic physics of high-temperature plasmas (plasma theory, RF heating, free electron lasers, development of advanced diagnostics and small-scall experiments on the Versator tokamak and Constance mirror devices), (b) major confinement results on the Alcator C tokamak, including pioneering investigations of the stability, heating, and confinement properties of plasmas at high densities, temperatures and magnetic fields, (c) operation of the medium-scale TARA tandem mirror, an axisymmetric confinement configuration with inboard thermal barriers, and (d) a broad program of fusion technology and engineering development that addresses problems in several critical subsystem areas (e.g., magnet systems, superconducting materials development, environmental and safety studies, advanced millimeter wave source development, and system studies of fusion reactor design, operation, and technology requirements).

46863 (SAIC—87/1088) Ponderomotive stabilization of external kink modes in tokamaks. D'Ippolito, D.A. (Science Applications International Corp., Boulder, CO (USA). Plasma Research Inst.). Jul 1987. Contract AC03-76ET53057. 27p. (PRI—112). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013840.

It is shown that external kink modes in tokamaks can be stabilized by applied radiofrequency (rf) waves in the ion cyclotron range of frequencies. This stabilization results from the work done by the plasma against the ponderomotive force exerted by the rf field. For a strongly evanescent surface field (such as the near field of an ion Bernstein wave coupler), the ponderomotive layer is confined to the vicinity of the plasma surface and, if sufficiently strong, influences kink stability in the same way as a close-fitting conducting wall. This effect is illustrated by deriving an analytic condition for stabilizing a single (m,n) mode in the low-beta straight tokamak model by means of a cylindrically-symmetric E/sub parallel/ rf field. The effects of poloidally or toroidally nonuniform rf fields are examined in a two-mode coupling perturbation analysis. This stabilization mechanism may be useful in extending the beta limit of ion-Bernstein-wave-heated tokamaks against both ideal and resistive modes.

46864 **(SAIC—87/1089) Two and three dimensional tokamak equilibrium modifications driven by localized ICRF [ion cyclotron range of frequencies] ponderomotive force.** Myra, J.R. (Science Applications International Corp., Boulder, CO (USA). Plasma Research Inst.). Aug 1987. Contract AC03-76ET53057. 45p. (PRI—113). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014694.

Large ponderomotive forces can occur when ICRF waves are employed in stabilization or high power heating schemes. It is shown that the MHD equilibrium of the plasma is modified when the rf antenna is localized poloidally and/or toroidally. In the 2D problem (toroidally uniform rf) a modified Grad-Shafranov equation describes ponderomotively driven magnetic surface distortions. At electric fuel strengths of interest for ICRF stabilization, the equilibrium distortions are small provided that L/sub rf/ << a and the poloidal localization of the rf is not severe. The character of the 3D problem (toroidally and poloidally varying rf) depends on whether or not the ponderomotive force couples to rational surface within the plasma. For the case without rational surfaces, the 3D component of the distortions is found to be small by 1/q/sub a/^{2} relative to the 2D component. In the case where rational surfaces are excited, magnetic islands result. A threshold condition for island overlap determines the rf electric field at which ergodicity may be expected. It is shown that ergodicity of the edge plasma may occur for some cases of interest for heating and stabilization, but should be controllable.

46865 **(UCB/ERL-M—87/18) Vortex dynamics and transport to the wall in a crossed-field plasma sheath.** Theilhaber, K.; Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 10 Apr 1987. Contract FG03-86ER53220. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013286.

Results of numerical simulations of the time-dependent behavior of a transversely magnetized plasma-wall sheath are presented. These simulations have been conducted with the aim of modelling plasma behavior in the vicinity of the limiters and walls of a fusion device. The two-dimensional, bounded particle simulation code "ES2" has been used as a tool for the investigation of these edge effects, in an idealized geometry which retains, however, the essential features of the physics of the edge plasma. The simulations have revealed that the bounded plasma is subject to the so-called "Kelvin-Helmholtz" instability, an instability maintained by the non-uniform electric field which is induced by the presence of the material walls. This instability is seen to saturate into large and stable vortices, with e phi/T/sub i/ ~ 1, which exist in the vicinity of the walls, and drift parallel to their surfaces. An important feature of these structures is that they continuously convect particles to the walls, at an "anomalous" rate much greater than that induced by collisional diffusion, a feature which seems tied to the mutual interaction of the vortices. In the code "ES2", volume ionization of neutrals has been modelled by a uniform electron-ion pair creation in the simulation region, and this results in a steady state, in which the linear edge instability, the nonlinear fluid dynamics of the vortices, and the nonlinear dynamics of the particles scattered by the vortices all balance each other. This steady-state but non-equilibrium configuration, which is a first model of the edge behavior induced by the boundaries, is conceptually analogous to Rayleigh-Benard convection.

46866 **(UCB/ERL-M—87/23) ES2 user's manual: Version 1.** Theilhaber, K. (California Univ., Berkeley (USA). Electronics Research Lab.). 11 May 1987. Contract FG03-86ER53220. 46p. NTIS, PC A03. File Number DE87013289.

The two-dimensional, electrostatic plasma simulation code "ES2" is described. This includes a synopsis of the physical basis of the model and a summary of the numerical schemes used to implement it. This is followed by two examples of applications, one showing the formation of unmagnetized double layers, the other illustrating the formation of vortices in a configuration perpendicular to the magnetic fields. Finally, the main section of the manual is presented: a copy of the "on-line" manual, in which a detailed description of the various options and parameters entering into ES2 is given.

46867 **(UCB/ERL-M—87/24) A relativistic Monte Carlo binary collision model for use in plasma particle simulation codes.** Procassini, R.J.; Birdsall, C.K.; Morse, E.C.; Cohen, B.I. (California Univ., Berkeley (USA). Electronics Research Lab.; Lawrence Livermore National Lab., CA (USA)). 14 May 1987. Contract FG03-86ER53220. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013287.

Particle simulations of plasma physics phenomena employ far fewer particles than the systems which are being simulated, owing to the limited speed and memory capacity of even the most powerful supercomputers. If the simulation consists of point particles in a gridless domain, then the combination of the small number of particles in a Debye sphere and the possibility of zero-impact-parameters, large-angle scattering results in a significant enhancement of fluctuation phenomena such as collisions. Collisional processes in a simulation may be difficult because of disparate time scales. A comparison of the relevant physical time scales of the system that is being simulated usually yields a large range of values. For instance, the grid-cell transit time is usually several orders of magnitude smaller than the 90° scattering time. Much of the physical phenomena of interest in the simulation are due to these long-time-scale collisional processes, but short-time-scale processes (such as particle bounce times in a mirror or tokamak) must be adequately resolved if the plasma dielectric response and the plasma potential are to be accurately determined. The following paper outlines the physics and operation of the binary collision model within the electrostatic code and presents the results of computer simulations of velocity space transport which were run to test the accuracy of the model. Also discussed are the timing statistics for the collision package relative to the other major physics packages in the code, as well as recommendations on the frequency of use of the collision package within the simulation sequence.

46868 **(UCB/ERL-M—87/34) Artificial cooling due to quiet injection in bounded plasma particle simulations.** Lawson, W.S. (California Univ., Berkeley (USA). Electronics Research Lab.). 21 May 1987. Contract AS03-76ET53064. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013288.

An explanation is proposed for an artificial cooling effect seen in electrostatic particle-in-cell plasma simulations. Further simulations are done which test and support the explanation.

46869 **(UCID—21123) Use of polarimetry to measure the current profile in MTX.** Nevins, W.M.; Hooper, E.B.; Bernstein, I.B. (Lawrence Livermore National Lab., CA (USA); Yale Univ., New Haven, CT (USA). Mason Lab.). 14 Jul 1987. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013835.

It is possible in principle to measure the poloidal magnetic field profile, and hence, the profile of the plasma current measuring the change in the polarization of a sequence of microwave beams that pass through the plasma. Actual measurements of the plasma current profile would be very interesting in connection with Lower-Hybrid (or EC) current drive experiments since this would provide direct information on modification of the current profile by the application of rf power. A microwave polarimetry diagnostic on MTX as part of the microwave interferometer is being considered. This diagnostic would be constructed in collaboration with Neville Luhmann and Tony Peebles at UCLA. The diagnostic would utilize the multicord far-infrared interferometer which is designed to operate at a base wavelength of 0.185 mm. This paper reviews the understanding of the physics issues raised by this diagnostic, concurring with Luhmann and Peebles' conclusion that the polarimetry measurements would be easier at longer wavelengths. An increase of only a factor of 2 in the wavelength would make a substantial difference since the signal to be measured goes as λ^4. Hence, in this paper operation at longer wavelengths (0.337 mm and 0.447 mm) in addition to operation at 0.119 and 0.185 mm will be considered.

46870 (UCRL—15918) Compact torus studies: Final report. Morse, E.C. (California Univ., Berkeley (USA). Coll. of Engineering; Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014254.

The compact torus (CT) device has been proposed for use in some applications which are of interest in Laboratory programs in the areas of pulsed power and inertial confinement fusion. These applications involve compression and acceleration of CT plasmas. The RACE (Ring Accelerator Experiment) experimental program at Livermore has been initiated to study these applications. The work reported here involves studies of plasma physics and other aspects of these compact torus applications. The studies conducted identify specific problem areas associated with the CT device and examine these areas in some detail. This report contains studies of three particular problem areas of the CT applications. These three areas are: the general nonlinear properties of the CT as a magneto-hydrodynamic (MHD) equilibrium, particle simulation of the compression of the CT, with a focus on the non-MHD effects, and nonlinear RF interaction problems in the CT.

46871 (UCRL—96666) Experimental results from TMX-U. Correll, D.L. (Lawrence Livermore National Lab., CA (USA)). 1 Aug 1987. Contract W-7405-ENG-48. 25p. (CONF-870908—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014094.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

This paper presents the recent results from the Tandem Mirror Experiment-Update(TMX-U). Many of these results can be divided into two major areas: (1) axial confinement and plasma potential, and (2) radial transport and total confinement (i.e., particle balance). Among the key observations to be discussed are the following: When the ion-confining potential θ/sub ic/ is small, θ/sub ic//T/sub i/ $\sim$ 1 to 2, the axial confinement time scales as the theoretical Pastukhov time. Deep thermal barriers (θ/sub b/ $\sim$ 0.7 kV, θ/sub b//T/sub e/ $\sim$ 6 to 7) have been measured, but there is no strong correlation between ion-confining potential and the thermal-barrier depth. By installing a calibrated H/sub α/ emission diagnostic to measure the ionization current, we have quantified particle balance between the ionization source current and the four plasma current channels: (1) axial losses, (2) nonambipolar radial losses, (3) ambipolar radial losses, and (4) density changes. All current channels are directly measured except for the ambipolar current, which is inferred from the particle balance equation. TMX-U operation above 1 to 3 x 10^{12} cm^{-3} is dominated by current channel (1) and below 1 x 10^{12} cm^{-3} by one or more of the remaining three channels. Central-cell particle buildup has been observed for one or two e-foldings and, within the radial core, found consistent with particle balance.

46872 (UCRL—96668) Microstability of the TMX tandem mirror experiments. Casper, T.A.; Berzins, L.V. (Lawrence Livermore National Lab., CA (USA)). 1 Aug 1987. Contract W-7405-ENG-48. 20p. (CONF-870908—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014356.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

In the tandem mirror device, an efficient source of warm ions, the central cell, is available for stabilization of ion loss-cone instabilities. These instabilities previously limited ion confinement in single-cell mirror experiments. In the simple tandem mirror device, TMX, the drift cyclotron loss-cone (DCLC) mode was stabilized by plasma flow from the central cell into the end cell. However, to enhance the central-cell confinement and provide MHD stability, neutral beams were injected perpendicular to the magnetic field, which resulted in the excitation in the end cell of the Alfven ion-cyclotron (AIC) instability driven by plasma pressure and velocity distribution anisotropy. In the thermal-barrier experiment, TMX-U, the end-cell beams were injected at a 45° angle to the magnetic field to produce a sloshing-ion distribution, which is required to form the thermal barrier and the plugging potential. Ion distributions created by oblique injection were stable to the AIC mode and to the midplane (minimum magnetic field location) DCLC mode. However, an ion loss-cone instability remained at an axial location just outside the outboard peak of the sloshing-ion axial density profile, which is the density peak closest to the end wall. This mode can enhance the sloshing-ion loss rate, particularly at the lower levels of electron-cyclotron resonance heating (ECRH) used to form the thermal barrier. The stability to ion-cyclotron modes is critical to the performance of tandem mirrors and to designs for a mirror-based, high-fluence neutron source.

46873 (UCRL—96828) Results from the RACE [Ring ACceleration Experiment] Compact Torus Acceleration Experiment. Hammer, J.H.; Hartman, C.W.; Eddleman, J.L.; Kusse, B. (Lawrence Livermore National Lab., CA (USA); Cornell Univ., Ithaca, NY (USA)). Jun 1987. Contract W-7405-ENG-48. 12p. (CONF-870631—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012176.

From 8. US symposium on compact toroid research and the 9. US/Japan workshop on compact toroids; College Park, MD, USA (4 Jun 1987).

RACE (Ring ACceleration Experiment) is a proof-of-principle experiment aimed at demonstrating acceleration of magnetically confined compact torus plasma rings to directed kinetic energies well in excess of their magnetic and thermal energies. In the course of the first year of operation the following have been observed: successful formation of rings in the RACE geometry; acceleration of rings with large forces, F/sub accelerate/ $\sim$F/sub equilibrium/ without apparent degradation of the ring structure; peak velocities of $\geq$2.5 x 10^8 cm/sec; acceleration efficiency of >30% at speeds of 1.5 x 10^8 cm/sec inferred from trajectory and capacitor bank data; kinetic to magnetic energy ratios $\sim$10 were observed. Experiments in the near future will be aimed at confirmation of the mass/energy measurements by calorimetry and direct density measurements.

46874 Effect of deuteron temperature on iron forbidden-line intensities in rf-heated tokamak plasmas. Sato, K.; Suckewer, S.; Wouters, A. (Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, New Jersey 08544-0451). *Physical Review [Section] A: General Physics;* **36**: No. 7, 3312-3321(1 Oct 1987).

Two line ratios, the forbidden line at 845.5 A ($2s\ ^2 2p\ ^2$P/sub 1/2/—$2s\ ^2 2p\ ^2$P/sub 3/2/) to the allowed line at 135.7 A ($2s\ ^2 2p\ ^2$P/sub 1/2/—$2s2p^2\ ^2$D/sub 3/2/) in Fe XXII and the forbidden line at 592.1 A ($2s\ ^2 2p^4\ ^3P_2$—$2s\ ^2 2p^4\ ^1D_2$) to the forbidden line at 1118.2 A ($2s\ ^2 2p^4\ ^3P_2$—$2s^2 2p^4\ ^3P_1$) in Fe XIX, have been measured as ion-temperature-sensitive line ratios during rf heating in the Princeton Large Torus. The results indicate that deuteron collisions in plasmas of high deuteron temperature have a noticeable effect on the intensity of the forbidden lines. Measured relative intensities are compared with values from level-population calculations, which include deuteron collisional excitation between the levels of the ground configuration. The agreement between the observed and calculated ratios is within 30%. A method for deuteron (or proton) temperature measurement in tokamak plasmas is discussed.

46875 Statistical closure approximations and the fluctuation-dissipation theorem for drift-wave interaction. Koniges, A.E.; Leith, C.E. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* **30**: No. 10, 3065-3074(Oct 1987). Contract W-7405-ENG-48.

The statistical dynamics of a truncated (three-wave) model for drift-wave interaction are studied using numerical simulation in order to determine appropriate turbulence modeling approaches. The nonlinear dynamical equation is integrated for a Gaussian ensemble of initial states, and time-lag correlation functions and infinitesimal response functions are computed. The fluctuation-dissipation relation, an assumption of many statistical closure approximations, is shown to be qualitatively valid for statistical steady states of the system. Guided by the ensemble results, a Markovian turbulence model is selected and investigated.

46876 Congruent reduction in geometric optics and mode conversion. Friedland, L.; Kaufman, A.N. (Lawrence Berkeley Laboratory and Physics Department, University of California, Berkeley, California 94720). *Physics of Fluids;* **30**: No. 10, 3050-3058(Oct 1987). Contract AC03-76SF00098.

Standard eikonal theory reduces, to N = 1, the order of the system of equations underlying wave propagation in inhomogen-

eous plasmas. The condition for this remarkable reducibility is that only one eigenvalue of the unreduced N x N dispersion matrix D(k,x) vanishes at a time. If, in contrast, two or more eigenvalues of D become simultaneously small, the geometric optics reduction scheme becomes singular. These regions are associated with linear mode conversion and are described by higher-order systems. A new reduction scheme is developed based on congruent transformations of D, and it is shown that, in degenerate regions, a partial reduction of order is still possible. The method comprises a constructive step-by-step procedure, which, in the most frequent (doubly degenerate) case, yields a second-order system, describing the pairwise mode conversion problem in four-dimensional plasmas. This N = 2 case is considered in detail, and dimensionality arguments are used in studying the characteristic ordering of the elements of the reduced dispersion tensor in mode conversion regions. The congruent reduction procedure is illustrated by classifying pairwise degeneracies in cold multispecies magnetized plasmas.

46877 **Collective effects on equilibria of trapped charged plasmas.** Turner, L. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 10, 3196-3203(Oct 1987).

A fluid model is used to study analytically the equilibria of charged plasma in traps. Several geometries are explored: a one-dimensional slab equilibrium of a finite-temperature plasma mechanically confined by two plates that are externally maintained at fixed potentials, and both spherical as well as spheroidal equilibria of a zero-temperature plasma confined in traps distorted from the standard Penning-trap configuration by virtue of the multipole moments of the trapped plasma. Although this study was motivated by the necessity of understanding possible collective effects in charged-plasma traps for the design and future diagnosis of the ambitious antiproton-gravity experiment being undertaken by the Los Alamos Collaboration [Proceedings of the Second Conference on the Intersections between Particle and Nuclear Physics (American Institute of Physics, New York, 1986), AIP Pub. No. 150, p.

46878 **Hamiltonian four-field model for nonlinear tokamak dynamics.** Hazeltine, R.D.; Hsu, C.T.; Morrison, P.J. (Institute for Fusion Studies and Department of Physics, University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **30**: No. 10, 3204-3211(Oct 1987).

The Hamiltonian four-field model is a simplified description of nonlinear tokamak dynamics that allows for finite ion Larmor radius physics, as well as other effects related to compressibility and electron adiabaticity. Much simpler than some previous descriptions of the same physics, it still preserves essential features of the underlying exact dynamics. In particular, because it is a Hamiltonian dynamical system it conserves the appropriate Casimir invariants, as well as avoiding implicit, unphysical dissipation. Here the model is derived and interpreted, its Hamiltonian nature is demonstrated, and its constants of motion are extracted.

46879 **Evolution of a decaying spheromak.** Sgro, A.G.; Mirin, A.A.; Marklin, G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 10, 3219-3236(Oct 1987).

The evolution of a low beta spheromak initially in a two-dimensional stable equilibrium having a constant J/B (the so-called minimum energy state) is calculated within the context of resistive magnetohydrodynamics. Since the initial equilibrium is stable, the spheromak at first resistively evolves through a sequence of stable quasiequilibria. This phase of the evolution is calculated with a transport code in which the resistivity is assumed to be largest at the wall and lowest at the magnetic axis. Resistive diffusion causes the safety factor q to decrease everywhere while decreasing fastest near the wall. The quasiequilibria through which the spheromak evolves are tested for stability with both an ideal linear stability code and a resistive one. The results of both stability codes are in basic agreement and show that when q drops to below (1)/(2) everywhere the spheromak becomes unstable to an n = 2 mode. The agreement of the stability codes implies that the unstable mode is a resistively modified ideal mode. The unstable equilibrium is used as the initial

46880 **Linear and nonlinear description of drift instabilities in a high-beta plasma.** Aydemir, A.Y.; Berk, H.L.; Mirnov, V.; Pogutse, O.P.; Rosenbluth, M.N. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **30**: No. 10, 3083-3092(Oct 1987).

A nonlinear system of equations is derived for drift waves in a high-beta plasma ($\beta >> 1$). The magnetic field pressure is taken small compared to the particle pressure. Pressure balance is established by having a uniform particle pressure with the density and temperature gradients in opposite directions. The primary purpose of the magnetic field is to inhibit radial heat flux. This is the principle of such plasma fusion systems as the wall sustained multiple mirror, compressed liner, and magnetic-insulated inertial fusion, where the heat is contained over a relatively short radial scale length and a long axial scale length. The nonlinear equations for the mathematical model contain drift instabilities that give rise to radial heat and particle fluxes that can enhance the losses expected from classical collisional effects. The linear and nonlinear evolution of the model is studied here.

46881 **Stimulated Raman scattering in self-focused light filaments in laser-produced plasmas.** Short, R.W.; Seka, W.; Bahr, R. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623-1299). *Physics of Fluids;* **30**: No. 10, 3245-3251(Oct 1987).

The stimulated Raman scattering instability is treated for laser light propagating through a plasma in a self-focused filament. It is shown that self-focusing of hot spots in the incident laser beam can greatly enhance the growth rate of the instability. This result may help to explain experimental observations of Raman scattering at nominal incident intensities well below the theoretical threshold, and may also account for an anomalous spectral structure that has been observed at low intensities.

46882 **Brillouin scattering measurements from plasmas irradiated with spatially and temporally incoherent laser light.** Mostovych, A.N.; Obenschain, S.P.; Gardner, J.H.; Grun, J.; Kearney, K.J.; Manka, C.K.; McLean, E.A.; Pawley, C.J. (Laser Plasma Branch, Plasma Physics Division, Naval Research Laboratory, Washington, DC 20375). *Physical Review Letters;* **59**: No. 11, 1193-1196(14 Sep 1987).

Stimulated Brillouin scattering spectra have been measured from plasmas produced by spatially and temporally incoherent laser light. The measured backscatter spectra and intensities differ substantially from measurements of Brillouin scattering with coherent illumination. Backscatter is strongly suppressed and the Brillouin signature in the spectra disappears. This quenching of stimulated Brillouin scattering is observed even when the laser coherence time is much larger (10 x) than the predicted convective saturation time of the stimulated Brillouin scattering instability.

46883 **Study of directly launched ion Bernstein waves in a tokamak.** Takase, Y.; Moody, J.D.; Fiore, C.L.; McDermott, F.S.; Porkolab, M.; Squire, J. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **59**: No. 11, 1201-1204(14 Sep 1987).

Excitation, propagation, and absorption of directly launched ion Bernstein waves were studied with CO_2 laser scattering in the Alcator C tokamak. Optimum excitation is obtained when an ion-cyclotron harmonic layer is located just behind the antenna. Wave absorption at the $\omega = 3\Omega$/sub D/ $= 1.5\Omega$/sub H/ layer was observed. 3 It may be necessary to control the edge density fluctuation level in order to minimize scattering of the ion Bernstein waves and optimize heating.

46884 **Electromagnetic direct implicit plasma simulation.** Hewett, D.W.; Langdon, A.B. (Physics Department, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Computational Physics;* **72**: No. 1, 121-155(Sep 1987). Contract W-7405-ENG-48.

A 2D electromagnetic version of the direct implicit PIC algorithm has been developed and implemented in the new code

AVANTI. The code has been tested on electron beam filamentation and magnetic reconnection problems and has fulfilled most of the promise of implicit PIC. It runs stably with an arbitrarily large time step and is quite robust with respect to large particle fluctuations that result when plasmas are represented with small numbers of particles per cell N/sub c/. Several numerical obstacles were overcome during the development of the AVANTI. A method of determining the implicit susceptibility chi is described which allows the code to avoid a nonlinear instability associated with small N/sub c/. We find a form of "simplified differencing" that provides a very robust algorithm without need for explicit smoothing. Another hurdle is the solution of the EM field equations. If the collisionless skin depth is not well resolved in high density regions, the terms containing the tensor chi dominate the E field equation and strongly couple the components. This strong coupling is handled by simultaneous solution of these equations: generalizing to simultaneous splitting in 2D. In regions where the skin depth is well resolved, terms associated with purely electromagnetic waves dominate but do not fit symmetrically into the simultaneous splitting scheme. Introducing the electrostatic potential, the troublesome asymmetric electrostatic part of E cancels but requires a fourth equation for phi to be solved simultaneously along with the three E components. Finally, extension and generalization of the conventional explicit PIC divergence correction step, necessary to maintain Gauss' law, is needed.

46885 Gyrokinetic particle simulation model. Lee, W.W. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Computational Physics;* **72**: No. 1, 243-269(Sep 1987).

A new type of particle simulation model based on the gyrophase-averaged Vlasov and Poisson equations is presented. The reduced system, in which particle gyrations are removed from the equations of motion while the finite Larmor radius effects are still preserved, is most suitable for studying low frequency microinstabilities in magnetized plasmas. The resulting gyrokinetic plasma is intrinsically quasineutral for λ/sub D/<<rho/sub s/ (equivalentrho/sub i/(T/sub e//T/sub i/)/sup 1/2/). Thus, without the troublesome space charge waves in the simulation, we can afford to use much larger time steps (ω/sub H/ Δtapprox. <1) and grid spacings (Δx/sub perpendicular//rho/sub s/approx. <1) at a much reduced noise level than we would have for conventional particle codes, where ω/sub H/equivalent(k/sub parallel//k/sub perpendicular/)(λ/sub D//rho/sub s/)ω/sub p//sub e/, and k/sub parallel/<<k/sub perpendicular/. Furthermore, it is feasible to simulate an elongated system (L/sub parallel/>>L/sub perpendicular/) with a three-dimensional grid using the present model without resorting to the usual mode expansion technique, since there is essentially no restriction on the size of Δx/sub parallel/ in a gyrokinetic plasma. The new approach also enables us to further separate the time and spatial scales of the simulation from those associated with global transport through the use of multiple spatial scale expansion.

46886 Enhanced stability and neutron production in a dense Z-pinch plasma formed from a frozen deuterium fiber. Sethian, J.D.; Robson, A.E.; Gerber, K.A.; DeSilva, A.W. (U. S. Naval Research Laboratory, Washington, D.C. 20375-5000). *Physical Review Letters;* **59**: No. 8, 892-895(24 Aug 1987).

We have formed dense Z pinches from frozen deuterium fibers ranging in diameter from 80 to 125 μm and at peak currents of up to 640 kA. The pinch remains stable for the entire 130 nsec of the current rise. This anomalously long stable period corresponds to about 100 MHD growth times. As soon as the current peaks, i.e., when dI/dt = 0, the pinch goes rapidly m = 0 unstable and produces nearly 10/sup 12/ neutrons in a 30—60-nsec-wide pulse. The instability occurs only at dI/dt = 0 and is independent of either the current magnitude or the time to peak.

46887 Mechanism for rapid sawtooth crashes in tokamaks. Aydemir, A.Y. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physical Review Letters;* **59**: No. 6, 649-652(10 Aug 1987).

The standard picture of Kadomtsev reconnection process predicts sawtooth crash times that are longer than those observed in the present day large tokamaks. Ideal kink modes are investigated as a possible mechanism for these fast crashes, by use of fully toroidal, compressible, full magnetohydrodynamic equations. In systems with low shear, parallel-current and pressure-driven modes are identified well below the previously accepted poloidal beta limits. Linear and nonlinear calculations show good agreement with experiments and indicate that such modes may explain fast collapse times reported in the recent literature.

46888 Anomalous temperature equilibria due to E x B drive. Mc Nally, J.R. Jr. *Fusion Technology;* **12**: No. 1, 166-169(Jul 1987).

The effect of E x B drive on enhancing ion temperature excursions in cylindrical or polar coordinates is discussed. Topics considered in this article include plasma engineering, thermal equilibrium, plasma diagnostics, and current-drive heating.

46889 Atomic data for highly charged ions. Applications to X-ray laser design and thermonuclear fusion. Younger, S.M. (Lawrence Livermore National Lab., CA). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **24/25**: No. 1, 373-376(Apr 1987). (CONF-861114—).

From 9. international conference on application of accelerators in research and industry; Denton, TX, USA (10 Nov 1986).

A detailed understanding of a myriad of atomic processes is proving important for the development of short wavelength lasers and to the achievement of controlled thermonuclear fusion. A brief overview of some X-ray laser design issues is presented along with a discussion of relevant atomic data needs. Special attention is given to the need for experimental verification of rate coefficient data which are important for determining laser kinetics. Approaches to magnetic and inertial confinement fusion are reviewed with emphasis on atomic processes affecting both fuel burn and plasma diagnostics. Recent advances in the development of high power ICF drivers, both lasers and particle beams, are shown to suggest new areas of research involving very highly charged ions in dense hot plasmas.

46890 Initial results from the DIII-D tokamak. Luxon, J.; Anderson, P.; Batty, F. (GA Technologies, Inc., San Diego, CA; Oak Ridge National Lab., TN). pp vp of Plasma physics and controlled nuclear fusion research 1986. Proceedings of the eleventh international conference on plasma physics and controlled nuclear fusion research held in Kyoto, 13-20 November 1986. Vienna, Austria; IAEA (1987). (CONF-861106—).

From IAEA international conference on plasma physics and controlled nuclear fusion research; Kyoto, Japan (12 Nov 1986).

The DIII-D tokamak was designed to exploit both (a) the strong dependence of limiting beta values and plasma energy confinement on high current, and (b) the effectiveness of the divertor configuration in obtaining good confinement. Initial operation of the device has resulted in Ohmic confinement (tau approx.= 150 ms) comparable to that of other large tokamaks and in low levels of plasma impurities (Z/sub eff/=1.5 at n-bar/sub e/=6×10^{19}m^{-3}). Both single null divertor and elongated dee shaped limiter plasmas have been produced. The paper reports both attaining H-mode confinement during beam heating of plasmas in open divertor configurations and values of the Troyon scaling quantity (I/aB approx.= 2) large enough to allow future studies of beta limits in regimes heretofore unattainable. 7 references, 6 figures, 1 table.

46891 Pellet injection results during TFTR Ohmic and neutral beam heating experiments. Schmidt, G.L.; Arunasalam, V.; Milora, S.L. (Princeton Univ., NJ; Oak Ridge National Lab., TN). pp vp of Plasma physics and controlled nuclear fusion research 1986. Proceedings of the eleventh international conference on plasma physics and controlled nuclear fusion research held in Kyoto, 13-20 November 1986. Vienna, Austria; IAEA (1987). (CONF-861106—).

From IAEA international conference on plasma physics and controlled nuclear fusion research; Kyoto, Japan (12 Nov 1986).

In Ohmic discharges, pellet injection experiments on TFTR have increased density limits and energy confinement. Injecting multiple pellets sustains the improved confinement and increases the central density and peaked character of the profile, producing sig-

nificant increases in n/sub e/(O)tau/sub E/(a). A value of (1.4 +- 0.3)x$10^{20}m^{-3}$center dots has been achieved at a central electron temperature of 1.4 keV. Decay of the central density for strongly peaked profiles in Ohmic discharges is consistent with central particle diffusion coefficients of 0.1 m^2/s and flow velocities on the order of neoclassical velocities. Concentrations of scandium injected following pellet injection (n/sub Sc//n/sub e/) exhibit an extended rise time and then remain roughly constant during the subsequent slow decay of the electron density. In pellet-fueled discharges heated by tangential neutral beams at high density, heating profiles vary from a flat radial shape to a profile that is peaked near the q=2 radius. Global confinement is comparable to that obtained in gas-fueled discharges with similar total input power but with heating profiles more strongly peaked on axis. Central confinement in pellet-fueled discharges exceeds values obtained in gas-fueled discharges. 11 references, 4 figures.

46892 **Recent advances in the theory and modelling of RF heating in inhomogeneous plasmas.** Swanson, D.G.; Cho, S.; Phillips, C.K.; Hwang, D.Q.; Houlberg, W.; Hively, L. (Auburn Univ., AL; Princeton Univ., NJ; California Univ., Davis; Oak Ridge National Lab., TN). pp vp of Plasma physics and controlled nuclear fusion research 1986. Proceedings of the eleventh international conference on plasma physics and controlled nuclear fusion research held in Kyoto, 13-20 November 1986. Vienna, Austria; IAEA (1987). (CONF-861106—).

From IAEA international conference on plasma physics and controlled nuclear fusion research; Kyoto, Japan (12 Nov 1986).

Theoretical and numerical modelling of rf heating in inhomogeneous plasmas is discussed. (1) A case is examined near the lower hybrid resonance where two turning points are encountered near one another, first from a cold to a warm wave and then from the warm wave to an ion Bernstein mode. This leads to a sixth order equation which is difficult to solve as it has a quadratic coefficient. (2) Improved a symptotic representations are presented whose accuracy is crucial to the numerical solution of this type of equation. (3) A new method of exact order reduction for higher order equations with no approximations permits generation of a numerical Green function by integrating only second order equations. The differential equation is factored with an asymptotically small source term. The resulting integral equation is more easily solved. (4) A formalism for determining the 2-D structure of the wave fields and the associated power deposition profiles within the mode conversion-absorption layer has been developed by applying the parabolic approximation method to the linearized Vlasov-Maxwell equations. The new method reduces the problem to the solution of one fourth order equation and an associated parabolic diffusion type equation. (5) Time dependent transport simulations of ICRF heated discharges in tokamaks with circular and non-circular cross-sections are presented. The simulations are obtained by interfacing the WHIST 2-D MHD equilibrium and a 1-D flux surface averaged transport code with a ray tracing algorithm. 11 references, 2 figures.

46893 **Drift wave models of tokamak confinement.** Waltz, R.E.; Dominguez, R.R.; Wong, S.K.; Diamond, P.H.; Hahm, T.S.; Mattor, N.; Lee, G.S. (GA Technologies, Inc., San Diego, CA; JAYCOR, San Diego, CA; Texas Univ., Austin; Oak Ridge National Lab., TN). pp vp of Plasma physics and controlled nuclear fusion research 1986. Proceedings of the eleventh international conference on plasma physics and controlled nuclear fusion research held in Kyoto, 13-20 November 1986. Vienna, Austria; IAEA (1987). (CONF-861106—).

From IAEA international conference on plasma physics and controlled nuclear fusion research; Kyoto, Japan (12 Nov 1986).

Drift wave models are used to explain the observed tokamak confinement scaling with density, power, size and magnetic field. Some additional edge mechanism is required to obtain the observed scaling with safety factor and to account for H-mode transitions. 11 references, 2 figures.

46894 **Computational methods for kinetic models of magnetically confined plasmas.** Killeeen, J.; Kerbel, G.D.; Mc Coy, M.G.; Mirin, A.A. New York, NY; Springer-Verlag New York Inc. (1986). 199p. Springer-Verlag New York Inc., 175 Fifth Ave., New York, NY 10010.

In this book authors present various types of nonlinear Fokker-Planck equations which require solution for the realistic computer simulation of magnetically confined plasmas. They present detailed mathematical arguements leading to numerically tractable simplifications and provide examples and applications bearing directly on the most recent technology in plasma research.

46895 **Numerical simulations of plasmas.** Dnestrovskii, Y.N.; Kostomarov, D.P. New York, NY; Springer-Verlag New York Inc. (1986). 304p. Springer-Verlag New York Inc., 175 Fifth Ave., New York, NY 10010.

This book presents a modern, consistent, and systematic development of numerical computer simulation of plasmas in controlled thermonuclear fusion. The authors focus on recent Soviet research in mathematical modeling of Tokomak plasmas and present kinetic hydrodynamic and transport models.

46896 **TuFF4. Half-integer harmonic emission from laser plasmas as a coronal temperature diagnostic.** Seka, W.; Short, R.W.; Goldman, L.M.; Letzring, S.; Richardson, M.C.; Soures, J.M.; Tanaka, K.; Craxton, R.S.; Delettrez, J.; Boni, R.; Quick, D. (Univ. of Rochester, NY). *Journal of the Optical Society of America B: Optical Physics;* **1**: No. 3, vp(Jun 1984).

Light emission at $omega_0/2$ and $3omega_0/2$ from laser plasmas has long been observed and associated principally with the 2omega/sub rho/ decay instability at n/sub c//4. Various theories have been developed to explain the spectra of this emission, which exhibits generally broad double-line features with a temperature-dependent splitting. Recent $omega_0/2$ spectra have, however, clearly shown additional features. Spherical target experiments with overlapping beams for optimum illumination uniformity are expected to exhibit more one-dimensional plasma blow-off behavior. Thus, predictions from one-dimensional theories adapted to spherical geometry should be applicable. The authors have tested this hypothesis on OMEGA with six overlapping UV (351-nm) beams on spherical targets. From these experiments the authors conclude that a much more one-dimensional plasma corona is indeed observed. However, the $3omega_0/2$ spectra observed under these conditions hardly lend themselves to quantitative coronal temperature diagnosis owing to the complex averaging of the spectra over the various angles of incidence on the spherical target surface as well as the various angles of emission with respect to the incident light. In contrast, the $omega_0/2$ spectra show a somewhat more complex structure, one component of which is well suited to coronal temperature diagnosis.

46897 **Summary abstract: measurement of impurities in a neutral beam by laser induced fluorescence.** Burrell, C.F.; Schlachter, A.S.; Pyle, R.V.; Searle, C.E. (Lawrence Berkeley Lab., CA). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 2, 708-709(Apr-Jun 1984). Contract AC03-76SF00098.

One objective of fusion research is to reduce the level of heavy impurity ions in magnetically confined plasmas. They cool the plasma by line radiation and serve as a target for electron capture by H^0 and D^0 beams prior to plasma penetration, thus preventing effective heating of the plasma. Impurity atoms injected along with the neutral beam of H^0 and D^0 used for heating and fueling the plasma are of particular concern because they are energetic and would penetrate into the plasma. A noninterfering, on-line diagnostic for detection of impurity atoms present in neutral hydrogen beams, by means of laser induced fluorescence (LIF) is described here.

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REFER ALSO TO CITATION(S) 46003, 46004

46898 **(CONF-8506177—Vol.1) Plasma-wall interaction data needs critical to a Burning Core Experiment (BCX).** (Sandia National Labs., Livermore, CA (USA)). Nov 1985. Contract AC04-76DR00789. 437p. NTIS, PC A19. File Number DE87013322.

From USDOE/Japan workshop Q52 plasma wall interaction data needs - critical to a burning core experiment (BCX); Livermore, CA, USA (24 Jun 1985).

The Division of Development and Technology has sponsored a four day US-Japan workshop "Plasma-Wall Interaction Data Needs Critical to a Burning Core Experiment (BCX)", held at Sandia National Laboratories, Livermore, California on June 24 to 27, 1985. The workshop, which brought together fifty scientists and engineers from the United States, Japan, Germany, and Canada, considered the plasma-material interaction and high heat flux (PMI/HHF) issues for the next generation of magnetic fusion energy devices, the Burning Core Experiment (BCX). Materials options were ranked, and a strategy for future PMI/HHF research was formulated. The foundation for international collaboration and coordination of this research was also established. This volume contains the first two of the five technical sessions. The first one being the BCX overview, the second on the BCX candidate materials. The remaining three sessions in volume two are on the plasma materials interaction issues, research facilities and small working group meeting on graphite, beryllium, advanced materials and future collaborations.

46899 **(CONF-8506177—Vol.2) Plasma-wall interaction data needs critical to a Burning Core Experiment (BCX).** (Sandia National Labs., Livermore, CA (USA)). Nov 1985. Contract AC04-76DR00789. 461p. NTIS, PC A20. File Number DE87013323.

From USDOE/Japan workshop Q52 plasma wall interaction data needs - critical to a burning core experiment (BCX); Livermore, CA, USA (24 Jun 1985).

The Division of Development and Technology has sponsored a four day US-Japan workshop "Plasma-Wall Interaction Data Needs Critical to a Burning Core Experiment (BCX)", held at Sandia National Laboratories, Livermore, California on June 24 to 27, 1985. The workshop, which brought together fifty scientists and engineers from the United States, Japan, Germany, and Canada, considered the plasma-material interaction and high heat flux (PMI/HHF) issues for the next generation of magnetic fusion energy devices, the Burning Core Experiment (BCX). Materials options were ranked, and a strategy for future PMI/HHF research was formulated. The foundation for international collaboration and coordination of this research was also established. This volume contains the last three of the five technical sessions. The first of the three is on plasma materials interaction issues, the second is on research facilities and the third is from smaller working group meetings on graphite, beryllium, advanced materials and future collaborations.

46900 **(CONF-8607190—Summ.) Division of Development and Technology Plasma/Materials Interaction and High Heat Flux Materials and Components Task Groups: Report on the joint meeting, July 9, 1986.** Watson, R.D. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Sep 1986. Contract AC04-76DP00789. 276p. NTIS, PC A13. File Number DE87013321.

From Division of development and technology plasma/materials interaction and high heat flux materials and components task groups; Albuquerque, NM, USA (9 Jul 1986).

This paper contains a collection of viewgraphs from a joint meeting of the Division of Development and Technology Plasma/Materials Interaction and High Heat Flux Materials and Components Task Groups. A list of contributing topics is: PPPL update, ATF update, Los Alamos RFP program update, status of DIII-D, PMI graphite studies at ORNL, PMI studies for low atomic number materials, high heat flux materials issues, high heat flux testing program, particle confinement in tokamaks, helium self pumping, self-regenerating coatings technical planning activity and international collaboration update. (LSP)

46901 **(CONF-8704118—2-Vugraphs) Status and results of systems code development and analysis.** Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011652.

From TIBER meetings; Livermore, CA, USA (6 Apr 1987).

This series of vugraphs describes the design goals of a computer code that will be used in designing the Engineering Test Reactor (ETR). (JDH)

46902 **(CONF-8704183—1-Vugraphs) World Stellarator Program.** Lyon, J.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 35p. NTIS, PC A03. File Number DE87009124.

From 4. TWP meeting; Naka, Japan (13 Apr 1987).

This report investigates the development of stellarator programs around the world. Some topics included are: the comparisons of stellarators and tokamaks, present understanding of stellarators, near-term stellarator program, next generation facilities and international cooperation programs. (LSP)

46903 **(CONF-8706184—1-Vugraphs) Fueling systems.** Gorker, G.E. (Oak Ridge National Lab., TN (USA); Grumman Aerospace Corp., Bethpage, NY (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013546.

From TIBER II review meeting; Oak Ridge, TN, USA (16 Jun 1987).

This report deals with concepts of the Tiber II tokamak reactor fueling systems. Contained in this report are the fuel injection requirement data, startup fueling requirements, intermediate range fueling requirements, power range fueling requirements and research and development considerations. (LSR)

46904 **(CONF-8706184—2-Vugraphs) TF & PF magnet power conversion.** Gorker, G.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013547.

From TIBER II review meeting; Oak Ridge, TN, USA (16 Jun 1987).

This paper contains a collection of data on the Tiber II Tokamak reactors magnet power conversion. The collection of data consists of: TF coil power conversion and protection system requirements and design data, TF power conversion cost estimates, PF coil power supply data and other Tiber systems data and circuit diagram presentations.

46905 **(DOE/DP/40200—38-Vol.29) LLE [Laboratory for Laser Energetics] review: Quarterly report, October-December 1986.** Delettrez, J. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1986. Contract FC08-85DP40200. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014468.

This volume of the LLE Review contains an analysis of the effect of laser illumination nonuniformity on the analysis of transport experiments; a review of measurements carried out with a high-resolution XUV spectrometer; a study of shock launching in silicon crystals; measurements of thermal conductivity in dielectric thin films; and the National Laser Users Facility activities for this period. Finally, the laser activities on GDL and OMEGA are summarized. The following are highlights of the research reports contained in this issue: (1) A method has been developed to study from simulations the effect of laser illumination nonuniformity on the interpretation of the transport experiments carried out with the 24 uv beams of OMEGA. (2) A high-resolution extreme uv spectrograph was used to study relativistic and quantum electrodynamic effects in high atomic number elements, to measure conditions in the coronal plasma, and to diagnose transitions in x-ray laser research. (3) The temporal variation of lattice spacing due to shocks launched into laser-irradiated silicon crystals was studied by Bragg x-ray diffractometry with pulsed x rays. (4) A method has been developed for measuring the thermal conductivity of dielectric materials in thin-film form. (5) A 25th beam from the output of the GDL active mirror laser system has been focused onto a target in the OMEGA chamber.

46906 **(DOE/DP/40200—53) Enhanced noise and Raman scattering in plasma.** Simon, A.; Short, R.W. (Rochester Univ., NY (USA). Lab. for Laser Energetics). Apr 1987. Contract FC08-85DP40200. 9p. (CONF-8704170—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014466.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

Observations of Raman scattering from laser-produced plasma have shown a number of puzzling features. These can be explained by assuming the presence of a bump-on-tail electron distribution created by pulses of fast electrons arising from instabilities at the critical (n/sub c/) or the quarter-critical (n/sub c//4) surface. Experiments using thin foils, in which the target density drops below n/sub c/ and even n/sub c//4 early in the laser pulse, have continued to show the same agreement as is seen for thick targets between the observed Raman spectrum and the predictions of this theory. This raises the issue of the time scale on which such directed pulses of fast electrons can continue to exist in the plasma after their source at n/sub c/ or n/sub c//4 disappears. We show that the classical degradation process is quite slow (of the order of 100 ps or more). Collective processes would appear to broaden and flatten the beam on a faster time scale. However, inclusion of finite spatial size strongly reduces the effect. Furthermore, we will show that broadening of the beam has little effect on the predicted spectrum.

46907 **(DOE/ER/52128—1) Fusion reactor physics and technology studies: Final report, December 1, 1985 to June 15, 1986.** Kulcinski, G.L.; Emmert, G.A.; Santarius, J.F.; Sviatoslavsky, I.N. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). Sep 1986. Contract FG02-86ER52128. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013691.

The work performed for "Fusion Reactor Physics and Technology Studies" was to participate with Lawrence Livermore National Laboratory (LLNL) and others in the design of the Minimars Tandem Mirror power reactor. This design activity was a collaborative effort with LLNL being responsible for the physics and program administration. The Fusion Technology Institute (FTI) of the University of Wisconsin was responsible for nuclear technology (central cell blanket/reflector/shield design, neutronics, activation, tritium issues, and end cell shielding), and the design of the central cell magnets. In addition, FTI provided assistance to LLNL on the plasma physics modeling of the plasma halo. An interim report on the Minimars design has been issued, and a final report covering all aspects of Minimars is in press. In addition, various reports and conference papers covering aspects of the design have been issued, and are listed in this report. A summary of the FTI contribution to the Minimars design study is presented.

46908 **(GA-A—18161) Fabrication of the new poloidal field coils for DIII-D.** Heiberger, M.; Bott, R.J.; Gallix, R.; Street, R.W. (GA Technologies, Inc., San Diego, CA (USA)). Dec 1985. Contract AC03-84ER51044. 7p. (CONF-851102—119). NTIS, PC A02. File Number DE87013379.

From 11. symposium on engineering problems in fusion research; Austin, TX, USA (18 Nov 1985).

The six new poloidal field coil assemblies manufactured by GA Technologies (GA) for DIII-D range in diameter from 3.4 to 5.3 m. Two of them are 55-turn field shaping coils. Each of the other four combines one turn of the ohmic heating coil and a 55-turn field shaping coil into a single unit encased in a stainless steel box beam. These four box beams, which provide support for the coils inside, are part of the overall coil and vacuum vessel support structure. They also serve as molds for vacuum impregnating the coils with epoxy. All coils are made of hollow, water-cooled copper conductor. The larger field shaping coils are designed for 20 kA, 3 sec rectangular current pulses with 40°C temperature rise. The ohmic heating coil turns are capable of currents of up to 110 kA. The conductor is wrapped with Kapton and fiberglass tape; Kapton provides 1000 V/turn and 28 kV coil-to-ground insulation. The fiberglass acts as wick and reinforcement for the vacuum impregnated epoxy resin which bonds the coil together. The fabrication process is described in detail and illustrated. Critical operations were: manufacturing of the large box beams and molds, braze joining the conductor lengths and fittings, correctly placing the Kapton insulation, completing the mold and vacuum impregnation, and fitting the overwrapped coil with leads and water fittings in its mold (or box beam). Tools and setups used for special operations such as induction brazing, conductor winding, conductor bending, and vacuum impregnation are presented. The quality control procedures followed to guarantee sound brazed joints are explained. The electrical tests performed at several stages of fabrication, especially the 1000 V/turn impulse tests conducted before potting to facilitate fault detection and repair, are described.

46909 **(GA-A—18862) DIII-D timing system.** Bramson, G. (GA Technologies, Inc., San Diego, CA (USA)). May 1987. Contract AC03-84ER51044. 23p. (CONF-870552—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE87012037.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

The DIII-D tokamak, an upgrade of Doublet III, a device to study magnetic confinement fusion at GA Technologies, became operational in February 1986. The new timing system consists of two major subsystems. The trigger subsystem synchronizes control and data acquisition for the experiment. The clock subsystem is a centralized source of pulses for data acquisition equipment. The CAMAC hardware and the database software for the DIII-D timing system is discussed.

46910 **(GA-A—18923) Numerical simulation of tokamaks: Ideal MHD [magnetohydrodynamics] equilibrium and stability.** Helton, F.J. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1987. Contract AC03-84ER53158. 9p. (CONF-870947—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013452.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

Great improvements have been made in numerical techniques, and in the processing speed and storage capacity of new supercomputers. The advent of supercomputers has brought about a revolution in fields which deal with physical phenomena that are amenable to numerical solution. The technique of computer simulation has allowed many previously inaccessible phenomena to be studied and has been especially valuable for applications in areas for which experimentation is either impossible or expensive, for example building tokamaks. Given the physics objectives of the tokamak and the economic and engineering constraints of the design, then, using the appropriate realistic numerical simulation techniques, an engineering design can be decided. However, the unrealistic, hence incorrect, use of powerful numerical simulations can easily lead to tokamak designs that will not be viable. In this paper remarks will be addressed only to the question of numerical simulation done for design purposes, clearly such remarks do not apply to theoretical studies in which theoretical (not necessarily realizable limits) are the major interest.

46911 **(HEDL-SA—3496-FP) Prospects for reduced activation alloys.** Doran, D.G.; Mann, F.M.; Rowcliffe, A.F. (Hanford Engineering Development Lab., Richland, WA (USA); Oak Ridge National Lab., TN (USA)). Apr 1986. Contract AC06-76FF02170. 7p. (CONF-860421—80). Elsevier Sci. Publ., B.V., 52 Vanderbilt Ave., New York, NY 10017. File Number TI87014368.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

The purpose of this paper is to describe the framework within which the development of alloys exhibiting reduced activation is being pursued in the US and to survey the current status and future prospects of this effort. The goal is to reduce activation to a level precluding the need for geologic disposal in order to help make fusion power environmentally and economically attractive. Initial efforts at reducing activation are aimed at replacing problem elements - especially Nb, Mo, and Ni - with more benign elements in analogues of structural alloys such as Ti-modified 316 stainless steel, the ferritic/martensitic steels containing 9 to 12% Cr, and the lower Cr (2%) ferritic/bainitic steels. The intrinsically low activation vanadium alloys are also under study; these are not common structural materials, so a data base is only slowly accumulating. Al-

though this work is at an early stage, it provides evidence for optimism that the goal can be met.

46912 **(HEDL-SA—3516) Effects of neutron irradiation to 63 dpa on the properties of various commercial copper alloys.** Brager, H.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1985. Contract AC06-76FF02170. 15p. (CONF-860421—78). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011714.

From 2. international conference on fusion reactor materials (ICFRM-2); Chicago, IL, USA (13 Apr 1986).

High purity copper and six commercial copper alloys were neutron irradiated to 47 and 63 dpa at about 450°C in the FFTF. Immersion density measurements showed a wide range of swelling behavior after irradiation to 63 dpa. At one extreme was CuBe in the aged and tempered (AT) condition which had densified slightly. At the other extreme was 20% CW Cu-0.1% Ag which swelled over 45%. Electrical resistivity measurements followed trends similar to previously published results for the same alloys irradiated to 16 dpa: a continued change in conductivity with fluence which appears to relate to void formation, transmutation products and coarsening of second phase precipitates. These results were compared with electrical conductivity of unirradiated alloys examined after aging for 10,000 hours. The most irradiation resistant high-conductivity copper alloys examined after 63 dpa are A125 and MZC. Cu-2.0Be, only a moderate-conductivity alloy, exhibits very consistent irradiation resistant properties.

46913 **(IPPJ-DT—132) Carbon film and its applications.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1986. 43p. (In Japanese). (CONF-8602136—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE87702942.

From Workshop on carbon coating; Wako, Japan (14 Feb 1986).

Diamond like carbon was prepared by the decomposition of methane in a microwave discharge. The effect of dilution gases, such as hydrogen, argon and helium, on the deposition was examined in the light of the identification of the deposits and the results of plasma diagnostics. When hydrogen was added, diamond like particles including large amounts of hydrogen were obtained. Diamond like films including graphitic carbon and a smaller amount of hydrogen were deposited from the methane-argon plasma. The correlation between the deposit and species present in the plasma is discussed. The deposition of diamond like carbon not including graphitic carbon from the methane-hydrogen plasma was succeeded because of the formation of CH/sub 3/ radicals having sp/sup 3/ hybrid orbital of carbon for diamond formation from the plasma and a removal of graphitic carbon from the deposit by sputtering.

46914 **(NAC—85-01) Calculations to obtain approximate field settings for the injection elements for given sector magnet field settings.** Rohwer, P.F.; Schneider, S. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1985. 12p. CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

Magnetic field measurements in the sector magnets will be carried out with the central region i.e. bending magnet 1 (BM1), bending magnet 2 (BM2) - and later possibly the magnetic inflection channel (MIC) - as well as the diagnostic equipment in position. In order to make realistic evaluations of these measurements, the flux densities in the injection elements have to correspond to the flux densities in the sector magnets. There is a definite relationship between the magnetic field setting of the injection elements and that of the sector magnets. The flux densities required for the six fieldsettings of the sector magnets at which the measurements will be carried out, is then calculated.

46915 (NP—7900797, pp 24-26) **Analysis of the FNS streaming experiment with albedo Monte Carlo method.** Kawai, Masayoshi; Yamauchi, Michinori; Seki, Yasushi. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Japan Atomic Energy Research Institute). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome Chiyoda-ku, Tokyo 100 Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

In the design of fusion reactors, there are several complicated ducts for the purpose of exhausting impurities and heating plasma. In order to analyze the radiation streaming through these ducts, an albedo Monte Carlo (AMC) method which enables coupled calculation for neutron and gamma-ray and several importance sampling techniques has been developed. Scoring methods by point detector and next event surface crossing estimator were also devised to take into account the contribution due to albedo reflection. These methods which were implemented in MORSE-I code have been used in the design of FER, and turned out to be effective to obtain data necessary for the design in reasonable computing time. However, it was also necessary to verify the nuclear data and calculational method for the shielding design of fusion reactors. In order to provide data for the verification, streaming experiments were carried out with Fusion Neutronics Source facility (FNS) of JAERI. Seki et al. analyzed the experiments with ordinary Monte Carlo method for some 500,000 histories of source neutrons and obtained excellent agreement between the measured and the calculated values. In the present work, the calculational accuracies with the neutron and gamma-ray coupled AMC method were confirmed through the analysis of the streaming experiments.

46916 (NP—7900797, pp 52-54) **Neutronics study of fusion-fission hybrid blanket in a swimming pool-type tokamak reactor.** Yamaoka, Mitsuaki; Kawashima, Masatoshi; Kamei, Takanobu; Murata, Toru; Inoue, Toyokazu; Seki, Yasushi; Iida, Hiromasa. (Nippon Atomic Industry Group Co., Ltd., Tokyo, Japan; Toshiba Corp.; Japan Atomic Energy Research Institute). 1985. Nippon Atomic Industry Group Co., Ltd., 1-7 Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100, Japan. File Number TI87900797.

In NAIG [Nippon Atomic Industry Group] annual review, 1984.

The fusion-fission hybrid reactor concept represents an effective method for producing fissile fuel from the fertile nuclides such as ^{233}U. The concept has potential advantage in the construction of a symbiotic electricity generation system with fission reactors. However, the problems in repair and maintenance of the reactor and exchange of the blanket module will be severer than pure fusion reactors due to the highly activated nuclear fuels. Application of the SPTR (Swimming Pool-Type Tokamak Reactor) concept to the fusion-fission hybrid reactor is expected to alleviate these problems. The SPTR, which is installed in a water pool, has advantage over the conventional tokamak reactor in retaining sufficient space for repair, maintenance and fuel exchange because a solid shield can be eliminated. The main objective of this study is to produce SPTR-type hybrid blanket concept of maximum neutronic performance consistent with mechanical and thermal design.

46917 **(PPPL—2448) Conditioning of the graphite bumper limiter for enhanced confinement discharges in TFTR.** Dylla, H.F.; LaMarche, P.H.; Ulrickson, M.; Goldston, R.J.; Heifetz, D.B.; Hill, K.W.; Ramsey, A.T. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1987. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013199.

A strong pumping effect has been observed with plasma operation on the toroidal graphite bumper limiter on TFTR. The pumping effect was induced by conditioning the limiter with a short series (10 to 20) of low density deuterium- or helium-initiated discharges. The density decay constant (tau/sub p/*) for gas-fueled ohmic discharges was reduced from tau/sub p/* $>$ 10 s before conditioning to a minimum value of tau/sub p/* = 0.15 s after conditioning, corresponding to a reduction in the global recycling coefficient from ~100% to less than 50%. Coincident with the low recycling conditions, low current neutral-beam-fueled discharges show global energy confinement times which are enhanced by a factor of two over results with an unconditioned limiter. Two models are proposed for the observed pumping effects: (1) a depletion model based on pumping of hydrogenic species in the near-surface region of the limiter after depletion of the normally saturated surface layer by (carbon and helium) ion-induced desorption; and (2) a codeposition model based on pumping of hydrogenic species

in carbon films sputtered from the limiter by the conditioning process.

46918 **(SAND—87-0140C-FP) A Shot Parameter Specification Subsystem for automated control of PBFA [Particle Beam Fusion Accelerator] II accelerator shots.** Spiller, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870656—1-FP). NTIS, PC A02. File Number DE87011854.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

The Shot Parameter Specification Subsystem (SPSS) is an integral part of the automatic control system developed for the Particle Beam Fusion Accelerator II (PBFA II) by the Control Monitor (C/M) Software Development Team. This system has been designed to fully utilize the accelerator by tailoring shot parameters to the needs of the experimenters. The SPSS is the key to this flexibility. Automatic systems will be required on many pulsed power machines for the fastest turnaround, the highest reliability, and most cost effective operation. These systems will require the flexibility and the ease of use that is part of the SPSS. The PBFA II control system has proved to be an effective modular system, flexible enough to meet the demands of both the fast track construction of PBFA II and the control needs of Hermes III at the Simulation Technology Laboratory. This system is expected to meet the demands of most future machine changes.

46919 **(UCRL—50021-85) Laser Program annual report, 1985.** Rufer, M.L.; Murphy, P.W. (eds.). (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 702p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE87011009.

This volume presents the unclassified activities and accomplishments of the Inertial Confinement Fusion and Advanced Laser Development elements of the Laser Program at the Lawrence Livermore National Laboratory for the calendar year 1985. This report has been organized into major sections that correspond to our principal technical activities. Section 1 provides an overview. Section 2 comprises work in target theory, design, and code development. Target development and fabrication and the related topics in materials science are contained in Section 3. Section 4 presents work in experiments and diagnostics and includes developments in data acquisition and management capabilities. In Section 5 laser system (Nova) operation and maintenance are discussed. Activities related to supporting laser and optical technologies are described in Section 6. Basic laser research and development is reported in Section 7. Section 8 contains the results of studies in ICF applications where the work reported deals principally with the production of electric power with ICF. Finally, Section 9 is a comprehensive discussion of work to date on solid state lasers for average power applications. Individual sections, two through nine, have been cataloged separately.

46920 (UCRL—50021-85, pp 2.1-2.90) **Target design.** Williams, E.A. (ed.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The Target Design Program combines the efforts of the plasma, code development, and design groups in three basic areas: developing theories of beam-plasma interaction, implosions, and thermonuclear microexplosions; building plasma and implosion-burn computer codes; and using the theoretical and computational tools to design targets and simulate experiments. Developments which are discussed are: cryogenic wetted-foam targets; electron transport in a steep-gradient high-flux regime; an electromagnetic direct-implicit particle code to enlarge the range of particles accessible to particle simulation; ion physics, and LASNEX code improvements.

46921 (UCRL—50021-85, pp 3.1-3.43) **Target development and fabrication.** Campbell, J.H. (ed.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The Target Development Group has the responsibility for turning theoretical target designs into working target systems. The unclassified targets under development generally fell into two broad categories, Inertial Confinement Fusion (ICF) related capsules and physics targets and x-ray laser targets. Other topics described are: development of an advanced target and prealignment system; spin polarized deuterium-tritium mixtures; and methods for producing liquid fuel layers. (FI)

46922 (UCRL—50021-85, pp 4.1-4.107) **Experiments and diagnostics.** Campbell, E.M.; McCauley, E.W.; Hawryluk, A.M.; Auerbach, J.M. (eds.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The primary activity of the Laser Experiments and Advanced Diagnostics Program (LEAD) has been to prepare the Nova target areas for the sophisticated inertial fusion, weapons physics, and extreme ultraviolet (XUV) laser experiments that will be fully under way in early 1986. The main tasks included the design, fabrication, installation, and activation of numerous diagnostics on both the ten-beam and two-beam target chambers. The activities described include: high-Z plasmas, exploding foils to study parametric instabilities; x-ray laser experiments; and diagnostic systems on the Nova target chambers. Additionally, the activities of the Data Management and Analysis Group are described.

46923 (UCRL—50021-85, pp 5.1-5.57) **Laser systems.** Foley, R.J.; Hunt, J.T. (eds.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The major accomplishments of the Laser Systems Group were completing activation of the Nova two-beam target chamber and developing the capability to do sophisticated, well-characterized target irradiation experiments in both the ten- and two-beam target chambers. The Nova laser system consists of the ten laser beams, the optical switchyard used for directing the beams and diagnosing beam quality, and the two target chambers. This section describes system elements, preparation, performance, and limitations. Testing of platinum-free, neodymium-doped phosphate laser glass is also described.

46924 (UCRL—50021-85, pp 6.1-6.54) **Laser and optical technology.** Campbell, J.H.; Powell, H.T.; Hunt, J.T. (eds.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The Nova laser system has evolved to the point that it is routinely used for conducting target physics experiments in the ten- and two-beam chambers. However, several unforeseen problems during the activation period were encountered. Glass disk damage is discussed and damage mechanism, damage reduction, and disk-edge cladding are discussed. Nonlinear optical effects the low efficiency of polarization-tuned harmonic converter crystals have also been investigated.

46925 (UCRL—50021-85, pp 7.1-7.142) **Laser research and development.** Powell, H.T. (ed.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The Advanced Laser Development (ALD) program has four principal objectives: to support the activation of the Nova laser system for inertial confinement fusion (ICF) experimentation; to develop a low-cost, 5- to 10-MJ laser for ICF research; to develop efficient, high-repetition-rate (1 Hz to 1 kHz), high-quality lasers for ICF reactor applications, for the medium-power solid state laser program of the Defense Advanced Research Projects Agency (DARPA), and for the free-electron laser program of the Strategic Defense Initiative Office (SDIO); and to conduct basic laser research for energy (Office of Basic Energy Science) and for special tasks such as the development of uv laser coatings for the Air Force Weapons Laboratory. This section describes the efforts in these areas as well as investigation of: damage in laser glasses, crystals and optical coatings; growth and understanding of nonlinear crystals; optical feedback, and flashlamp properties.

46926 (UCRL—50021-85, pp 8.1-8.61) **ICF applications.** Orth, C.D. (ed.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The major thrust of Inertial Confinement Fusion (ICF) Applications this year has been to demonstrate that ICF power reactors can be economically competitive as well as safer and less harmful to the environment than fission or coal plants. The design for the Cascade reactor has established a new benchmark and standard for ICF reactors: A future design will receive attention only if it is likely to outperform Cascade. This year trends in the power industry were examined and related to fusion reactor design, and the methodology for future comparisons was developed. Finally, new reactor ideas were examined and considerations were given as to how to develop ICF for multiple applications. An economic analysis of ICF reactors and a study of power demand are also presented.

46927 (UCRL—50021-85, pp 9.1-9.92) **High-average-power lasers.** Gagnon, W.L. (ed.). Nov 1986. NTIS, PC A99/MF A01. File Number DE87011009.

In Laser Program annual report, 1985.

The goals of the High-Average-Power Laser Program at LLNL are to develop a broad technology base for solid state lasers and to demonstrate high-average-power laser operation with more efficiency and higher beam quality than has been possible with current technology. Major activities are the zig-zag laser testbed and the gas-cooled-slab laser test bed. This section describes these activities as well as discussion of material development; nonlinear optics; laser materials, and applications.

46928 **(UCRL—93129) Laser-driven instabilities in long scalelength plasmas.** Kruer, W.L. (Lawrence Livermore National Lab., CA (USA)). 31 Jul 1985. Contract W-7405-ENG-48. 27p. (CONF-8507117—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87012908.

From 29. Scottish Universities summer school in physics: laser plasma interactions; St. Andrews, UK (28 Jul 1985).

In this update lecture we focus on laser-driven instabilities in long scalelength underdense plasmas. Particular attention is given to some recent experiments on Raman scattering of intense laser light. Many important features are in accord with theoretical expectations. These features include a correlation of hot electron generation with Raman scattering, an increase in this scattering as the density scale length increases, and collisional suppression of the instability. Some challenging aspects of the growing data base as well as various deficiencies in the understanding are discussed. The role of the plasmon decay instability 2ω/sub pe/, Brillouin, and filamentation instabilities is also briefly considered.

46929 **(UCRL—95283) Optical damage in polymers by millisecond light pulses.** Wolfe, C.R.; Campbell, J.H.; Lyon, R.E.; Pitts, J.H.; Powell, H.T. (Lawrence Livermore National Lab., CA (USA)). Nov 1986. Contract W-7405-ENG-48. 31p. (CONF-861124—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013106.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (3 Nov 1986).

Optical damage in epoxy based polymers used to attach absorbing cladding onto the edge of laser disks of the Nova Laser has been studied. Damage was produced by exposing the polymers to a 20-40 J/cm^2 fluence of broad band Xe-flashlamp light having a pulse length of approximately 0.5 ms. This simulates the flashlamp light used to pump high power Nd:glass laser amplifiers. The predominant damage mechanisms appear to be pyrolysis, associated with absorbing inclusions and photolysis, associated with intrinsic absorption of the polymer. The amount of damage can be minimized be careful filtering of the polymer to reduce the presence of foreign material and by minimizing the near uv absorption of the polymer and the uv emission of the flashlamps.

46930 **(UCRL—95544) Alarm points for fixed oxygen monitors.** Miller, G.C. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 17p. (CONF-870609—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012911.

From American industrial hygiene conference; Montreal, Canada (1 Jun 1987).

Oxygen concentration monitors were installed in a vault where numerous pipes carried inert cryogens and gases to the Mirror Fusion Test Facility (MFTF-B) experimental vessel at Lawrence Livermore National Laboratory (LLNL). The problems associated with oxygen-monitoring systems and the reasons why such monitors were installed were reviewed. As a result of this review, the MFTF-B monitors were set to sound an evacuation alarm when the oxygen concentration fell below 18%. We chose the 18% alarm criterion to minimize false alarms and to allow time for personnel to escape in an oxygen-deficient environment.

46931 **(UCRL—95981) Laser-plasma-interaction experiments using multikilojoule lasers.** Drake, R.P. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 27p. (CONF-8705172—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013483.

From 18. European conference on laser interaction with matter; Prague, Czechoslovakia (4 May 1987).

This paper summarizes the results of several laser-plasma-interaction experiments using multikilojoule lasers, and considers their implications for laser fusion. The experiments used 1.06, 0.53, 0.35, and 0.26 μm light to produce relatively large, warm, planar plasmas and to study the effect of laser wavelength and density-gradient scale length on the Stimulated Raman Scattering and on the scattering of light at frequencies near the incident laser frequency by Stimulated Brillouin Scattering or other processes. The results of these experiments suggest that some laser wavelength between 0.2 and 0.6 μm will be required for high-gain laser fusion.

46932 **(UCRL—97188) Integral measurements and calculations of neutron and gamma-ray emission at 14 MeV and an overview of the new multi-user tandem at LLNL.** Hansen, L.F. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 14p. (CONF-870959—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014351.

From International conference on neutron physics; Kiev, USSR (21 Sep 1987).

In this paper two topics will be presented: (a) the integral measurements and calculations of gamma-ray and neutron emission spectra due to a source of 14 MeV neutrons from materials of interest to thermonuclear reactors and (b) an overview of the new multi-user accelerator facility being built at LLNL. Under (a), recent measurements of the gamma-ray and neutron leakage spectra from materials ranging from Be to ^{238}U pulsed with 14 MeV neutrons are presented. The Monte Carlo calculational analysis using the codes TART and SANDYL with the ENDL and ENDF/B-V photon-neutron libraries is discussed. Under (b), details of the new multi-disciplinary laboratory centered around a 10 MV Van de Graaff with four ion sources and 19 experimental beam lines will be given. The experimental program to be carried out in this facility will be discussed. 19 refs., 4 figs., 2 tabs.

46933 **(UCRL—97215) Magnetic mirror fusion systems: Characteristics and distinctive features.** Post, R.F. (Lawrence Livermore National Lab., CA (USA)). 10 Aug 1987. Contract W-7405-ENG-48. 18p. (CONF-870908—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013798.

From Course and workshop on physics of mirrors, reversed field pinches and compact tori; Varenna, Italy (1 Sep 1987).

A tutorial account is given of the main characteristics and distinctive features of conceptual magnetic fusion systems employing the magnetic mirror principle. These features are related to the potential advantages that mirror-based fusion systems may exhibit for the generation of economic fusion power.

46934 **Theory of induced spatial incoherence.** Lehmberg, R.H.; Schmitt, A.J.; Bodner, S.E. (Naval Research Laboratory, Washington, DC 20375). *Journal of Applied Physics;* 62: No. 7, 2680-2701(1 Oct 1987).

This paper describes theoretical and experimental investigations of induced spatial incoherence (ISI), a technique for achieving the smooth and controllable target beam profiles required for direct-drive laser fusion. In conventional ISI, a broadband laser beam (coherence time t/sub c/ = $1/\Delta\nu << t$/sub pulse/) is sliced into an array of mutually incoherent beamlets by echelon structures that impose successive time delay increments $\Delta t > t$/sub c/. A focusing lens then overlaps those beamlets onto the target, which is usually located at the far field. Here, we evaluate the ideal target

beam profiles for practical ISI focusing configurations, and examine the perturbing effects of transient interference, laser aberration, and plasma filamentation. Analytic and numerical calculations show that nonuniformities due to interference among the beamlets are smoothed by both thermal diffusion and temporal averaging. Under laser-plasma conditions of interest to inertial confinement fusion (ICF), average ablation pressure nonuniformities —1% should be readily attainable. We also investigate a partial ISI scheme, which allows widely spaced beamlets to remain mutually coherent; the resulting high spatial frequency interference structure can be effectively smoothed by thermal diffusion alone. A perturbation analysis shows that the average target profile <I(x)> remains relatively insensitive to laser beam aberration when the scale length of that aberration is larger than the initial beamlet width. This aberration will tend to broaden and smooth <I(x)>, rather than introduce any small-scale structure.

46935 **Neutral-beam current drive in tokamaks.** Devoto, R.S. (Lawrence Livermore National Laboratory, University of California, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **158**: No. 1, 716-726(30 Jul 1987). (CONF-8610115—).

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The theory of neutral-beam current drive in tokamaks is reviewed. Experiments are discussed where neutral beams have been used to drive current directly and also indirectly through neoclassical effects. Application of the theory to an experimental test reactor is described. It is shown that neutral beams formed from negative ions accelerated to 500-700 keV are needed for this device.

46936 **Updated reference design of a liquid-metal-cooled tandem mirror fusion breeder.** Berwald, D.H.; Whitley, R.H.; Garner, J.K.; Gromada, R.J.; Mc Carville, T.J.; Moir, R.W.; Lee, J.D.; Bandini, B.R.; Fulton, F.J.; Wong, C.P.C. (Grumman Aerospace Corp., Bethpage, NY 11714). *Fusion Technology;* **12**: No. 1, 30-70(Jul 1987).

The current version of a reference design for a liquid-metal-cooled tandem mirror fusion breeder (fusion-fission hybrid reactor) is summarized. The design update incorporates the results of several recent studies that have attempted to resolve key technical issues that were associated with an earlier reference design completed in 1982. The issues addressed relate to the following areas of design and performance: nuclear performance, magnetohydrodynamic (MHD) pressure loading, beryllium multiplier lifetime, structural efficiency and lifetime, reactor safety, corrosion/mass transfer, and fusion breeder capital cost. The updated blanket design provides increased performance and reduced technological risk in comparison with earlier fission-suppressed hybrid blanket designs. Specifically, the blanket is expected to achieve a net fissile breeding ratio (per fusion) of 0.84, with a tritium breeding ratio of 1.06, and an average blanket energy multiplication of 2.44. It would operated at a relatively low neutron wall loading (1.7 MW/m/sup 2/) with a low lithium coolant outlet temperature (425°C).

46937 **Special features of first-wall heat transfer in liquid-metal fusion reactor blankets.** Taghavi, K.; Tillack, M.S.; Madarame, H. (Univ. of Kentucky, Dept. of Mechanical Engineering, Lexington, KY 40506). *Fusion Technology;* **12**: No. 1, 104-113(Jul 1987).

The presence of strong magnetic fields and of volumetric heat generation in the fusion reactor environment result in an unusual heat transfer situation for liquid metals, as compared to nonconducting coolants. The effects of velocity profiles and volumetric heat generation on heat transfer in liquid-metal blankets are examined both analytically and numerically. Analysis shows that unlike the fully developed Nusselt number, the spatial dependence within the entry region is relatively insensitive to the shape of the velocity profile and the amount of bulk heating. Hence, closed form solutions for fully developed heat transfer can be used together with a normalized entrance region curve to estimate heat transfer throughout the blanket.

46938 **Power transport to the poloidal divertor experiment scoop limiter.** Kugel, H.W.; Budny, R.; Fonck, R.; Goldston, R.; Grek, B.; Kaita, R.; Kaye, S.; Knize, R.J.; Manos, D.; Mc Cann, R. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544). *Fusion Technology;* **12**: No. 1, 145-152(Jul 1987).

Power transport to the Poloidal Divertor Experiment graphite scoop limiter was measured during both ohmic- and neutral-beam-heated discharges by observing its front face temperatures using an infrared camera. Measurements were made as a function of a plasma density, current, position, fueling mode, and heating power for both co- and counter-neutral beam injection. The measured thermal load on the scoop limiter was 25 to 50%. of the total plasma heating power. The measured peak front face midplane temperature was 1500°C, corresponding to a peak surface power density of 3 kW/cm/sup 2/. This power density implies an effective parallel power flow of 54 kW/cm/sup 2/ in agreement with the radial power distribution extrapolated from television Thomson scattering and calorimetry measurements.

46939 **Similarities between the plasma vortex filaments (relativistic and nonrelativistic) observed in the plasma focus and in conventional relativistic electron-beam machines.** Bostick, W.H. (Stevens Institute of Technology, Hoboken, NJ 07030). *Fusion Technology;* **12**: No. 1, 92-103(Jul 1987).

In 1966, the Stevens Institute of Technology (SIT) plasma focus group demonstrated experimentally that the current sheath of the plasma focus is carried by pairs of plasma vortex filaments, which exhibit a force-free, Beltrami-type morphology. Experiments at SIT in 1980 and at the Air Force Weapons Laboratory (AFWL) show that relativistic electron beams traveling through a background gas of — 1 Torr, and even in a "vacuum" diode, exhibit the same type of filamentary morphology, but on a spatial dimension scale, which extends down to the 1-μm region. Some of the experimental evidence accumulated in work at AFWL from 1979, to 1981, which supports the statement that there is a close similarity between current-carrying morphologies of the plasma focus and the relativistic beam machines, is presented.

46940 **Abel inversion using transform techniques.** Keefer, D.R.; Smith, L.M.; Sudharsanan, S.I. (Center for Laser Applications, The Univ. of Tennessee Space Institute, Tullahoma, TN 37388). pp 50-58 of Proceedings of ICALEO '86. Toledo, OH; Laser Institute of America (1986). (CONF-861197—).

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

A method is presented for calculating the reconstruction of a circularly symmetric two-dimensional function from its projection, a relation known as the Abel inversion. This technique differs from techniques used previously by using integral transforms for its implementation. The frequency-domain analysis allows for experimentally obtained data, which is often noisy and off-center, to be dealt with in a systematic, rational manner. The formulation of the Abel inversion in terms of transforms, the filtering of the noise, and the estimate of the off-center shift are discussed. Sample calculations of simulated noisy data and the application of the method to an image of a laser sustained plasma are presented.

46941 **Noncollisional absorption of femtosecond laser pulses in plasmas by nonlinear forces.** Miley, G.H.; Batchelor, M.T.; Hora, H.; Sherrin, M.M.; Stening, R.J. (Univ. of Illinois, Fusion Studies Lab., 103 S. Goodwin Ave., Urbana, IL). pp 192 of Digest of technical papers from the OSA/IEEE 1985 conference on lasers and electro-optics. Washington, DC; Optical Society of America (1985). (CONF-850558—).

From Conference on lasers and electro-optics; Baltimore, MD, USA (21 May 1985).

Since subpicosecond laser pulses have become available, study of their interaction and absorption in plasma is of interest on account of the nonlinear force process. In these cases electric field generation and the presence of double layers in the plasma are important as is known from the caviton mechanisms, and a first estimation of the absorption processes involved now has to be evaluat-

ed for the necessary relativistic conditions. The dynamics is described by the nonlinear forces with full inclusion of the Poynting term. The results of the solution are given in this paper. The authors find a relatively strong absorption process which might assist high-energy transfer to plasmas for fusion using subpicosecond ripple in the laser pulse. It further allows one to study basic plasma processes which could not be treated before the advent of femtosecond pulses. In turn, thin plasma foils can be used for diagnostics of the femtosecond pulses and for detection of their parameters. A new type of dynamic mechanism for a limitation of femtosecond laser pulses (or their high-frequency analog) in any dielectric material (e.g., in fibers) is evaluated.

46942 **TuFF3. Self-focusing in underdense ultraviolet laser-produced plasmas.** Tanaka, K.; Boswell, B.; Craxton, R.S.; Goldman, L.M.; Richardson, M.C.; Seka, W.; Short, R.W.; Soures, J.M. (Univ. of Rochester, NY). *Journal of the Optical Society of America B: Optical Physics;* **1**: No. 3, vp(Jun 1984).

Ultraviolet laser-matter interaction processes are of considerable interest to laser fusion. Among these processes, filamentation (or self-focusing) is of particular importance, since it could prevent attainment of the illumination uniformity required for high target compression. In addition self-focusing may complicate the interpretation of target interaction experiments. Self-focusing has been studied experimentally by side-on x-ray pinhole camera photography and backscatter spectrometry. These results are compared with two-dimensional simulations using the hydro code SAGE, which is well suited to model thermal self-focusing (no ponderomotive forces are included in these simulations).

46943 **Summary abstract: description and performance of uranium beds used to pump tritium-deuterium at the Tritium Systems Test Assembly.** Walthers, C.R. (Los Alamos National Lab., NM). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 2, 722-723(Apr-Jun 1984).

The Tritium Systems Test Assembly (TSTA), a full size simulation of the fuel loop for a fusion reactor, will circulate 360 g mol/day (1800 g) of DT and will have an inventory of 150 g of tritium. During shutdown, a safe storage system for hydrogen isotopes, primarily DT, is needed. Uranium reacts readily with hydrogen, deuterium, or tritium at room temperatures to form U(H, D, T)$_3$ having a dissociation pressure of approximately 10^{-4} Torr. Upon heating to 720 K, the isotopes will desorb at pressures of 1 to 2 atm. Uranium beds were selected as the means for long-term storage of the fuel loop inventory.

99 GENERAL AND MISCELLANEOUS

46944 **(ANL/TIS—87-1) Argonne National Laboratory 1985 publications.** Kopta, J.A. (ED.); Hale, M.R. (comp.). (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 239p. NTIS, PC A11. File Number DE87014450.

This report is a bibliography of scientific and technical 1985 publications of Argonne National Laboratory. Some are ANL contributions to outside organizations' reports published in 1985. This compilation, prepared by the Technical Information Services Technical Publications Section (TPB), lists all nonrestricted 1985 publications submitted to TPS by Laboratory's Divisions. The report is divided into seven parts: Journal Articles - Listed by first author, ANL Reports - Listed by report number, ANL and non-ANL Unnumbered Reports - Listed by report number, Non-ANL Numbered Reports - Listed by report number, Books and Book Chapters - Listed by first author, Conference Papers - Listed by first author, Complete Author Index.

46945 **(BNL—52015) The first forty years, 1947-1987.** Rowe, M.S. (ed.); Cohen, A.; Petersen, B. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87014717.

This report commemorates the fortieth anniversary of Brookhaven National Laboratory by representing a historical overview of research at the facility. The chapters of the report are entitled: The First Forty Years, Brookhaven: A National Resource, Fulfilling a Mission - Brookhaven's Mighty Machines, Marketing the Milestones in Basic Research, Meeting National Needs, Making a Difference in Everyday Life, and Looking Forward.

46946 **(SAND—87-1320C) Errors associated with Russian name transliteration.** Pasterczyk, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871087—3). NTIS, PC A02. File Number DE87011717.

From Conference of American Translators Association; Albuquerque, NM, USA (7 Oct 1987).

Works from the Soviet Union form a significant portion of the world's sci/tech literature. Because information is increasingly being stored in machine-readable form and most western keyboards are unable to accommodate Cyrillic characters, some sort of conversion scheme between the Cyrillic and Roman alphabets is necessitated. Unfortunately, no clear agreement exists in theory or in practice of which scheme would be "best," hence a multitude are currently in use. The belief that a one-to-one mapping exists between Russian and English is naive. One can view the transliteration process as movement within a multi-dimensional matrix with the following dimensions: source script, target script, conversion scheme, time, intended usage of conversion, context of word, character to be converted, and where the character appears in the word. Errors can occur along any axis of the matrix and accumulate as movement within the matrix takes place. Error introduction into online databases can be reduced by translating and transliterating only from original language documents and introducing some kind of authority control, automated and/or intellectual.

46947 **(SAND—87-1509C) All translations are not created equal.** Newman, P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871087—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010492.

From Conference of American Translators Association; Albuquerque, NM, USA (7 Oct 1987).

Buyers who select a translator on the basis of a low bid are frequently unaware of the many factors that affect translation value. This article suggests that other parameters, such as translation errors, document importance, delivery time and convenience, may be of equal weight in the selection of a translation service. Arbitrary numerical values are assigned to the range of variation within a particular parameter, and comparative values are calculated.

46948 **(SAND—87-1557C) Foreign language identification: First step in the translation process.** Newman, P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-871087—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011065.

From Conference of American Translators Association; Albuquerque, NM, USA (7 Oct 1987).

Guidelines are given for identifying 16 European languages that use the Latin alphabet by means of the diacritical marks used with particular letters. It is not necessary to know the languages to identify them. Five Slavic languages can be identified on the basis of the Cyrillic letters they use or do not use. Guidelines are also given for discriminating between Chinese, Japanese and Korean.

9901 Management

46949 **(INIS-mf—10955) Uses of atomic energy for the economic and social development in the German Democratic Republic.** (Council of Ministers, Berlin (German Democratic Republic)). 1987. 59p. (CONF-870309—). NTIS (US Sales Only), PC A04/MF A01. File Number DE87702908.

From United Nations conference for the promotion of international co-operation in the peaceful uses of nuclear energy; Geneva, Switzerland (23 Mar 1987).

Also published in German.

A report is given on the peaceful uses of atomic energy in the GDR. The following topics are discussed: (1) present state and

prospects of the utilization of atomic energy in the GDR, (2) protection against the dangers from the use of atomic energy, (3) the GDR's share in international efforts to secure the peaceful uses and to further the development of atomic energy, and (4) conclusions for the enhancement of international cooperation in the peaceful uses of atomic energy. 2 tabs., 6 figs., and 23 color and 3 black-and-white plates are included.

46950 **(SAND—86-2829C) Documentation as a management strategy for reaching goals in high-risk research-oriented projects.** Shirley, C.G. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-8710103—2). NTIS, PC A02. File Number DE87012394.

From Project Management Institute seminar/symposium; Milwaukee, WI, USA (2 Oct 1987).

The paper reports experience bearing especially on construction projects in an R & D environment. From experience has come a set of principles about the key purposes of documentation. The paper first describes characteristics of a project environment that combines research and construction, then goes on to discuss basic project management goals that documentation can help the manager reach. The final sections present some specifics of documentation that may assist project managers who are considering what kind of documentation their projects need.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 45989

46951 **(AD-A—181398/9/XAB) Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements. Annual report, 1 January-31 December 1986.** Schafer, R.W.; Paris, D.T. (Georgia Inst. of Tech., Atlanta (USA). School of Electrical Engineering). 1 Jan 1987. 47p. NTIS, PC A03/MF A01.

This is an annual report on research conducted under the auspices of the Joint Services Electronics Program. Specific topics covered are: digital-signal processing, parallel-processing architectures, two-dimensional optical storage and processing, hybrid optical/digital signal processing, electromagnetic measurements in the time domain, and automatic radiation measurements for near-field and far-field transformations.

46952 **(AD-A—181613/1/XAB) Transformation of broadcasting into pipelining. Research report.** Wong, Y.; Delosme, J.M. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). Jun 1987. 34p. (YALEU/DCS/RR—544). NTIS, PC A03/MF A01.

A characteristic shared by many computation-intensive algorithms is the repeated usage of a few data values in a sequence of computations. An efficient parallel implementation of these data dependences often requires the simultaneous transfer, or broadcasting, of the data values to all the processors that need them. Unfortunately, direct realization of this broadcasting operation on VLSI processor arrays, especially on systolic arrays, usually results in severe performance degradation. A technique for decomposing broadcasting dependences into propagation dependences at the algorithm level is presented in this paper. Such propagation dependences, when physically realized, result in pipelining. The determination of a feasible propagation scheme is formulated as a linear algebra problem. It is proven that all broadcastings can be decomposed into propagations, and a systematic method for finding such decompositions is proposed.

46953 **(AD-A—181748/5/XAB) Parallel structure for online identification and adaptive control. Master's thesis.** Kim, Y.H. (Naval Postgraduate School, Monterey, CA (USA)). Mar 1987. 75p. NTIS, PC A04/MF A01.

The author investigated the possibility of employing parallel-computing structures for adaptive identification and control. The identification algorithm is based on recursive least-squares with covariance resetting and block-processing technique. It is shown how a parallel-processing structure can be obtained by recursively applying Givens Rotation to the data matrix. Due to the regularity of its structure, the approach presented is particularly attractive for VLSI implementation.

46954 **(ANL—87-31) REDUCE-aided study of a problem in Hermitian matrix theory.** Kwong, M.K. (Argonne National Lab., IL (USA)). Jul 1987. Contract W-31109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014331.

Let A be any n x n positive definite matrix and B any n x n non-negative definite matrix. In an earlier paper we showed that for each n there is a real number t/sub n/ > 2 such that if $t <$ t/sub n/ then the solution X of the matrix equation $A^2X + XA^2 + tAXA = B$ is non-negative definite. For $n = 2$, $t_2 = \infty$ and for $n = 3$, t/sub 3/ $= 8$. In this report we show that t/sub 4/ $= 4$, t/sub 5/ < 3.02048507 and t/sub 6/ < 2.62120330.

46955 **(ANL/MCS-TM—92) Evaluating computers and their performance: Perspectives, pitfalls, and paths.** Dongarra, J.; Martin, J.; Worlton, J. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Jun 1987. Contract W-31109-ENG-38. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014264.

Various considerations relating to the evaluation of computer systems and their performance are presented with particular emphasis on the issue of benchmarking. In this context, the issue of workload analysis and the subsequent justification of benchmark authenticity based on correlation to the workload is discussed as well as the need to limit variables in the analysis process. The objective has been to present a guide to some of the considerations and approaches involved in the benchmarking and performance evaluation of computers. Special attention will be given to supercomputers because of the extremely high cost associated with their development, procurement, and use as well as the urgent need of users to obtain the highest speeds possible for their computations.

46956 **(ANL/MCS-TM—93) Un-Skolemizing clause sets.** McCune, W.W. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). May 1987. Contract W-31109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014265.

This note addresses the following problem. Given a set S of clauses and a set of constant and function symbols F that occur in the clauses of S, obtain a fully quantified (closed) formula S′ from S by replacing expressions starting with symbols in F with existentially quantified variables. S′ must be unsatisfiable if and only if S is unsatisfiable. A sound (but not complete) solution is given in the form of an outline of an algorithm.

46957 **(ANL/TM—451) NJE enhancements to NBI OASys mail.** Carlson, R.A.; Errion, S.M. (ed.). (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014330.

NJE Enhancements to NBI OASys Mail supplements the NBI OASys Mail Reference Guide (S200848) published by NBI Inc. The NBI vendor document covers the base Mail package (e.g., setting up tailors, alias lists), a package that allows NBI users to communicate with other NBI users on the same Integrated Control Unit (ICU) and to communicate with other NBI users on another ICU, when the ICUs are interconnected. NJE Enhancements to NBI OASys Mail assumes that you already know how to send mail to and receive mail from other NBI OASys users. It provides NBI users with necessary supplemental information for using "Gateway" Mail, which allows NBI users to communicate with Argonne computer users on the IBM mainframe or divisional VAX computers (see Appendix A for a description of the NBI configuration with the central Argonne computers and Table 1 for a list of Argonne nodenames) and to communicate with other research centers and universities through BITnet. By using Gateway Mail, NBI users can send and receive electronic mail to and from other computers on the network simply by using OASys Mail commands. NBI users type the same commands to communicate with external users via Gateway Mail as they use when communicating with other NBI users via OASys Mail.

46958 (ANL/TM—453) A plan for administrative computing at ANL FY1988 through FY1990. Hale, D.O.; Bretscher, M.E.; Hischier, R.C.; Moore, N.J. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87014715.

The introduction (Chapter 1) of the FY1988 through FY1990 Long-Range Plan assesses the state of administrative at ANL and the implications of FY 1988 funding recommendations. Chapter 2 of this document discusses the strategy and goals which are an important part of administrative data processing plans for the Laboratory. Chapter 3 describes the management guidelines established by the Administrative Data Processing Oversight Committee for the proposal and implementation of administrative computing systems. The guidelines are a valuable tool for management in determining what applications would be appropriate to their needs and in formulating the proposals for those applications. Summaries of the proposals for new or enhanced administrative computing systems presented by individual divisions or departments with the assistance of the Information Systems Section of Computing Services to the Administrative Data Processing Oversight Committee appear in Chapter 4. The summaries indicate some of the possibilities for the development of administrative computing systems at ANL. The areas of the various proposals are diverse, but they share a common concern with the integration and unification of existing systems into a more efficient and productive whole. The detailed tables in Chapter 5 give information on how much the resources to develop and implement a given system will cost its users. The tables include development costs, computing/operations costs, software and hardware costs, and effort costs. They include both systems funded by Laboratory General Expense and systems funded by the users themselves.

46959 (BNL—51916-Vol.2) Preconditioned iterative methods applied to singularly perturbed elliptic boundary value problems: Volume 2. Goldstein, C.I. (Brookhaven National Lab., Upton, NY (USA)). Jan 1987. Contract AC02-76CH00016. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014337.

It is the purpose of this report to modify and extend results in a previous report, concerning a class of multigrid preconditioners developed for use in the iterative solution of singularly perturbed elliptic boundary value problems. Typically, the low order derivative terms are multiplied by a large parameter, K. The preconditioner was based on a "partial" multigrid V cycle applied to the discrete LaPlacian, -Δ/sup h/, where h is the grid size. By this, we mean that the coarse grid residual problem is not solved. At most, one or a few relaxation sweeps are applied on this grid level. The multigrid preconditioner is now extended to include the W cycle applied to -Δ/sup h/ as well as -Δ/sup h/ + K^2. It is shown how to choose the coarsest grid size as a function of K, h, and the type of multigrid cycle in order to obtain optimal convergence of the preconditioned iterative method. It is proved that the low frequency subspace is scaled by $0(K^{-2})$ for both the V and W cycles. For the W cycle, it is proved that the multigrid preconditioner is norm equivalent to $(-\Delta/\text{sup h/} + K^2)^{-1}$, uniformly in both K and h. The results are proved using Fourier analysis.

46960 (CONF-870633—1) Extending Green's function formalism to general nonlinear equations. Cacuci, D.G.; Perez, R.B.; Protopopescu, V. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013541.

From 4. workshop on nonlinear evolution equations and dynamical systems; Montpellier, France (11 Jun 1987).

Forward and backward propagators are canonically obtained for general nonlinear problems and shown to be the natural generalizations of the Green's functions used to solve linear problems. The propagators obey a reciprocity relationship and satisfy a closed nonlinear integral equation. The formalism is applied on an illustrative example.

46961 (CONF-870832—2-Draft) Applications of artificial intelligence in the US nuclear industry. Uhrig, R.E. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014414.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

In the US, the development of expert systems in the nuclear power field is being carried out by a wide spectrum of organizations, i.e., vendors, architect-engineer firms, universities, national laboratories, Federal agencies, the electric utility industry, and small entrepreneur groups. The most coherent development program is the Electric Power Research Institute program to demonstrate the usefulness of artificial intelligence in a number of areas, including augmenting plant automation and an agreement to transfer the technology of NASA's multi-year AI "Core Technology in Systems Autonomy" to the nuclear power industry. A few vendors are offering commercial products that reduce the burden on reactor operators during both normal and abnormal operation. Several AI programs at universities and national laboratories have automation as their primary focus. Many individual AI projects have been initiated under the SBIR (Small Business Innovative Research) program. The fundamental and synergistic relationship between training and expert systems supports the use of artificial intelligence in the training of nuclear personnel. In the long run, the most significant contribution of artificial intelligence may well be the introduction of AI programming techniques. With multi-million line computer codes contemplated for automated nuclear plants, the ability to readily modify programs and utilize verified and validated "building blocks" of code offer extraordinary advantages.

46962 (CONF-870984—3) Power transformation of the sample kurtosis. Bowman, K.O.; Shenton, L.R. (Oak Ridge National Lab., TN (USA); Georgia Univ., Athens (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010012.

From 46. session of the International Statistical Institute; Tokyo, Japan (8 Sep 1987).

The distribution of the sample kurtosis from general populations are considered. In most cases, its distribution is far from normal especially small samples. Power transformations turn out to be effective in reducing its skewness to near zero and its kurtosis close to the normal value three. Four moments approximating distributions are used to approximate percentage points. Applications to simulation studies should reduce the cycle size significantly for simulation stability.

46963 (CONF-8706178—1) On the relational modeling of discrete PDE problems. Balaban, D.; Garbarini, J.; Olwell, K.; Greiman, W.; Shlaer, S. (Lawrence Livermore National Lab., CA (USA); Project Technology, Inc., Berkeley, CA (USA)). 1987. Contract W-7405-ENG-48. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87013336.

From International symposium on AI, expert systems and languages in modelling and simulation; Barcelona, Spain (2 Jun 1987).

We have created a knowledge representation scheme for discrete partial differential equation (PDE) problems which makes possible the mechanical creation of simulation programs has been created. This knowledge representation scheme is based on: three fundamental relations between observables, densities, currents, and sources which provide a framework for a large class of physics problems; and partitioning spacetime to provide a framework for defining a discrete system of equations by specifying approximations to spacetime current integrals on spacetime partitions.

46964 (DOE/ER—0342) Summaries of the FY 1987 Applied Mathematical Sciences Research program. (USDOE Office of Energy Research, Washington, DC. Scientific Computing Staff). Aug 1987. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014447.

The purpose of this report is to provide a convenient compilation of summaries of the individual research projects that constitute the Applied Mathematical Sciences research subprogram managed by the Director, Scientific Computing Staff, Office of the Director of Energy Research, Department of Energy. This office, organized in 1984, consists of the Applied Mathematical Sciences Research activity formerly under the Division of Engineering, Mathematical and Geosciences, Office of Basic Energy Sciences, Office of Energy Research, and the management of the Energy Sciences

Advanced Computation activity. The areas included in this report are: analytical and numerical methods, information analysis techniques, advanced computing concepts, energy science advanced computation and capital equipment.

46965 **(DOE/ER/25009—423) Finite elements for 2D elliptic equations with moving nodes.** Williams, R.D. (California Inst. of Tech., Pasadena (USA)). [1987]. Contract FG03-85ER25009. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013501.

A Finite Element algorithm for minimizing a homogeneous variational principle which is a quadratic in the function derivatives is described. The minimization is with respect to the (possibly vector-valued) function at the nodes, and also with respect to the nodal positions and the connectivity of the mesh. The elements are linear triangles, the mesh is automatically generated, and may be locally refined if a user-supplied refinement criterion is satisfied. The problem domain may have arbitrary shape, but must have the topology of a disk, and either Dirichlet or Neumann conditions may be specified at each point of the boundary. An example is given of a problem from elasticity theory.

46966 **(DOE/ER/25009—443) Benchmarking the Connection Machine.** Baillie, C.; Felten, E.; Walker, D. (California Inst. of Tech., Pasadena (USA)). [1987]. Contract FG03-85ER25009. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013500.

The purpose of this memo is to present the results of work done recently on the Connection Machine during a one-week visit by the authors to Thinking Machines Corporation. The main objectives of the trip were to benchmark the Connection Machine and to assess the software environment, in order to determine the suitability of the Connection Machine for solving computationally-intensive problems and to compare the Connection Machine with other highly-parallel computers. This report presents preliminary results, and describes the computer architecture.

46967 **(DOE/ER/25026—9) Implementation of preconditioned s-step Conjugate Gradient methods on a multiprocessor system with memory hierarchy.** Chronopoulos, A.T.; Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Aug 1987. Contract FG02-87ER25026. 30p. (UIUCDCS-R—87-1347; UILU-ENG—87-1750). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014401.

Multiprocessor architectures combining vector and parallel processing capabilities on a two-level shared memory structure have been implemented. This memory hierarchy structure requires that numerical algorithms possess good data locality in order to achieve high performance rates. The s-step Conjugate Gradient method is a generalization of the classical method with improved data locality and parallel properties. Numerical experiments on a multiprocessor with memory hierarchy show the superiority in performance of the s-step methods to their one-step counterparts.

46968 **(FNAL/C—87/93) The VAXONLINE software system at Fermilab.** White, V.; Heinicke, P.; Berman, E.; Constanta-Fanourakis, P.; MacKinnon, B.; Moore, C.; Nicinski, T.; Petravick, D.; Pordes, R.; Quigg, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1987. Contract AC02-76CH03000. 6p. (CONF-870552—23). NTIS, PC A02. File Number DE87013565.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

The VAXONLINE software system, started in late 1984, is now in use at 12 experiments at Fermilab, with at least one VAX or MicroVax. Data acquisition features now provide for the collection and combination of data from one or more sources, via a list-driven Event Builder program. Supported sources include CAMAC, FASTBUS, Front-end PDP-11's, Disk, Tape, DECnet, and other processors running VAXONLINE. This paper describes the functionality provided by the VAXONLINE system, gives performance figures, and discusses the ongoing program of enhancements.

46969 **(FNAL/Pub—87/105-A) Wilson loop instantons.** Lee, K.; Holman, R.; Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics). Jun 1987. Contract AC02-76CH03000. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013480.

Wilson Loop symmetry breaking is considered on a spacetime of the form $M_4 \times K$, where M_4 is a four dimensional spacetime and K is an internal space with non-trivial and finite fundamental group. We show in a simple model that the different vacua obtained by breaking a non-Abelian gauge group by Wilson loops are separated in the space of gauge potentials by a finite energy barrier. An interpolating gauge configuration between these vacua has been constructed and it has been shown to have minimum energy. Finally, some implications of this construction are discussed.

46970 **(HD-PY—87/05) Behaviour at unit argument of the hypergeometric function /sub 3/F/sub 2/.** Buehring, W. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.). 1987. 15p. Heidelberg Univ., Germany, F.R. Physikalisches Inst. .

The behavior at z=1 of the generalized hypergeometric function /sub 3/F/sub 2/(a,b,c;e,f;z) is investigated. First the analytic continuation near z=1 is obtained for the general case when s=e+f-a-b-c is not equal to an integer. The corresponding continuation formulas for the special cases when s is equal to an integer are then derived by appropriate limiting processes. When f=c or e=c, the formulas immediately reduce to the well-known continuation formulas of the Gaussian hypergeometric function.

46971 **(KFKI—1986-96/A) Monte Carlo method and its application in the experimental particle physics.** Manno, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1986. 85p. (In Hungarian). NTIS (US Sales Only), PC A05/MF A01. File Number DE87703120.

This article describes the basic principles of the Monte Carlo method. After a brief summary of the used concepts and results of the probability theory and after introducing the important discrete and continuous probability distributions, the problem of random number generation is discussed in detail. Different methods of random number generation are presented with examples in computer codes. The transformation of the primer homogeneous distribution to other, e.g. Gauss exponential or multidimensional ones is discussed. The application of the Monte Carlo method in particle physics is illustrated by some examples related to neutron absorption and to the reliability of laboratory equipment. An important application field of the MC method is the numerical evaluation of definite integrals. Some methods fastening the convergence are discussed. An example is worked out in detail: the determination of effectivity of a detection system, designed for the detection of kaon-proton interaction. The computer code of the MC program is added. (D.Gy.). 7 refs.; 30 figs.

46972 **(KFKI—1987-03/G) Dynamic studies in the primary coolant circuits Pt. 1/I. Computerized analysis of the simultaneous drop-out of 6 major pumps based on experiments at a high-pressure loop 'PMK-NHV'.** Szabados, L.; Ezsoel, Gy.; Perneczky, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1987. 69p. (In Hungarian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87703123.

The theoretical works related to the experiment performed on the PMK-NHV high-pressure water cooled loop of the CRIP modelling the total loss of flow in the Paks NPP are presented. The pre-test analysis with the RELAP4/mod6 code, the evaluation of the measured thermohydraulic data, the interpretation of the results and the post-test calculation are summarized. 7 refs.; 49 figs.; 6 tables.

46973 **(LA—10855-MS) ICS: An implicit Compton-Fokker-Planck Solver.** Morel, J.E. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014208.

A computer software package for solving the time evolution equations for the electron temperature, ion temperature, and multigroup radiation densities resulting from Compton-Fokker-Planck scattering is described.

46974 **(LA—10920-MS) Computer modeling of metal forming.** Korzekwa, D.A.; Guerra, F.M.; Follansbee, P.S.; Stout, M.G. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013804.

A program to develop the capability to model metal forming operations is in progress. Two forming operations were chosen as model problems for evaluating the accuracy of existing codes and determining their applicability for these types of problems. Detailed inspection of the parts produced by these operations supplied experimental results for comparison with the model. The material chosen for study, 304L stainless steel, was characterized to provide material properties for the study. The operations were modeled with two different finite element codes - ADINA78 and NIKE2D. The results indicate that forming operations where friction is not important can be modeled with reasonable accuracy for isotropic materials. The results for a thin sheet problem indicate that when friction is a dominant factor the existing codes have deficiencies that can cause large errors. In the course of this investigation a new friction model that seems to offer some improvement was implemented in both codes. 34 refs., 53 figs., 3 tabs.

46975 **(LA—11025-M) A reference guide for IGVIEW, an IGES-compatible [Initial Graphics Exchange Specification] geometry system.** Dolin, R.M.; Jaeger, D.L. (Los Alamos National Lab., NM (USA)). Aug 1987. Contract W-7405-ENG-36. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013441.

This report provides an introduction to the Initial Graphics Exchange Specification (IGES)-compatible code called IGVIEW. This software is used to display, edit, and analyze two-dimensional IGES formatted geometry. IGVIEW was written to comply with IGES Version 4.0, which is the current national geometry standard. This report is intended to serve as a reference manual for IGVIEW users. It contains a description of all possible commands and how to execute them. It details how to execute the code, read in a geometry file, and write a geometry file. There is also a discussion about what types of computer systems and terminals the current version of IGVIEW will support. The procedures for developing a material library are shown, and a short example library is provided.

46976 **(LA—11068-M) Configuration and operation of a PC-based waveform scroller/data acquisition system.** Pillay, G.; Cokal, E.J. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87014221.

The DATAQ Instruments WFS-200PC Waveform Scroller Card is a plug-in board for IBM personal computers and compatibles, providing display, recording, and storage functions for up to eight channels of input from voltage sources such as laboratory instruments, thermocouples, etc. It is in effect an eight-channel replacement for a strip chart recorder. By using the WFS-200 with any of a large number of supported analog/digital converter (ADC) boards, data can be recorded digitally in the supporting computer's RAM or mass storage. This report describes a user-configured system, consisting of the MetraByte DAS-8 board, the DATAQ Waveform Scroller Card, and DATAQ's Computer-Based Oscillograph and Data Acquisition System (CODAS) software, which may be used with any instruments that generate analog output to display, scale, and record these waveforms in real time with a single computer, using no complicated programming syntax.

46977 **(LA-UR—87-1860) Electronic authoring tools.** Hurford, J.M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-871086—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011797.

From Institute of Electrical and Electronic Engineers Professional Communication Society conference; Winnipeg, Canada (14 Oct 1987).

More than a decade ago, word processing software revolutionized the way documents were prepared, and productivity was increased. But the editing and formatting capabilities of most word processors did very little to prevent errors in spelling, typing, grammar, diction, style, or organization from slipping through to the final documents. In the past few years, the number of software tools that aid the author has increased substantially. They now vary in scope from simple spelling checkers to sophisticated diction analyzers and idea processors. Moreover, writing-aid-software described in this report is now available for many types of computing systems, including personal computers, scientific workstations, and mainframes. The various pieces of software can be used in interactive or non-interactive (batch) modes.

46978 **(LA-UR—87-2367) Modeling shockwave deformation via molecular dynamics.** Holian, B.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870753—46). NTIS, PC A02. File Number DE87013157.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Molecular dynamics (MD), where the equations of motion of up to thousands of interacting atoms are solved on the computer, has proven to be a powerful tool for investigating a wide variety of nonequilibrium processes from the atomistic viewpoint. Simulations of shock waves in three-dimensional (3D) solids and fluids have shown conclusively that shear-stress relaxation is achieved through atomic rearrangement. In the case of fluids, the transverse motion is viscous, and the constitutive model of Navier-Stokes hydrodynamics has been shown to be accurate - even on the time and distance scales of MD experiments. For strong shocks in solids, the plastic flow that leads to shear-stress relaxation in MD is highly localized near the shock front, involving a slippage along close-packed planes. For shocks of intermediate strength, MD calculations exhibit an elastic precursor running out in front of the steady plastic wave, where slippage similar in character to that in the very strong shocks leads to shear-stress relaxation. An interesting correlation between the maximum shear stress and the Hugoniot pressure jump is observed for both 3D and fluid shockwave calculations, which may have some utility in modeling applications. At low shock strengths, the MD simulations show only elastic compression, with no permanent transverse atomic strains. The result for perfect 3D crystals is also seen in calculations for 1D chains. It is speculated that, if it were practical, a very large MD system containing dislocations could be expected to exhibit more realistic plastic flow for weak shock waves, too.

46979 **(LA-UR—87-2602) A methodology for fabrication of intelligent discrete-event simulation models.** Morgeson, J.D.; Burns, J.R. (Los Alamos National Lab., NM (USA); Texas Tech Univ., Lubbock (USA). Coll. of Business Administration). 1987. Contract W-7405-ENG-36. 7p. (CONF-8710124—2). NTIS, PC A02. File Number DE87013177.

From Conference on systems, man, and cybernetics; Alexandria, VA, USA (20 Oct 1987).

In this article a meta-specification for the software requirements and design of intelligent discrete next-event simulation models has been presented. The specification is consistent with established practices for software development as presented in the software engineering literature. The specification has been adapted to take into consideration the specialized needs of object-oriented programming resulting in the actor-centered taxonomy. The heart of the meta-specification is the methodology for requirements specification and design specification of the model. The software products developed by use of the methodology proposed herein are at the leading edge of technology in two very synergistic disciplines - expert systems and simulation. By incorporating simulation concepts into expert systems a deeper reasoning capability is obtained - one that is able to emulate the dynamics or behavior of the object system or process over time. By including expert systems concepts into simulation, the capability to emulate the reasoning functions of decision-makers involved with (and subsumed by) the object system is attained. In either case the robustness of the technology is greatly enhanced.

46980 **(RFP—4090) Color graphics on programmable logic control systems.** Brown-Vanhoozer, S.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 11p. (CONF-871028—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011052.

From Instrument Society of America international conference and exhibit; Anaheim, CA, USA (5 Oct 1987).

Color graphics in Progammable Logic Control (PLC) based systems allow the operator and engineer to monitor or control industrial processes from either local or remote consoles. Since a number of color graphic packages are currently available for PLC interfacing, an evaluation was conducted to determine which color graphics package to select. This paper discusses key elements of the selection process.

46981 **(SAND—86-2384C) A design methodology for the utilization of metrics within various phases of software lifecycle models.** Pollock, G.M.; Sheppard, S. (Sandia National Labs., Albuquerque, NM (USA); Texas A and M Univ., College Station (USA). Dept. of Computer Science). 1987. Contract AC04-76DP00789. 22p. (CONF-871081—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010519.

From 11. annual international computer software and applications conference; Tokyo, Japan (5 Oct 1987).

A design methodology for implementing an automatable set of elementary measures that can be used in constructing composite or hybrid software metric prototypes is presented. Metric kernel primitives developed with this methodology are utilized to construct new hybrid metrics that can be applied to programs implemented in different languages and to various phases of software lifecycle models. The primary intent of the methodology is to provide a technique and subsequent environment that will enhance research in the metric area. Initial evaluations of the design methodology have investigated the application of software complexity metrics to the maintenance phase of the traditional lifecycle model. Actual primitives have been developed in the Ada/sup TM/ programming language to aid in constructing software complexity metrics. Prototypes of Halstead's metric and McCabe's Cyclomatic Complexity metric were constructed from the primitives to evaluate the design methodology. The prototypes can analyze programs written in either FORTRAN or COBOL. An environment to support the design methodology has been defined and is under development.

46982 **(SAND—87-0027) HECTR [Hydrogen Event Containment Transient Response] Version 1.5N: A modification of HECTR Version 1.5 for application to N Reactor.** Camp, A.L.; Dingman, S.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 174p. (UNI—4332). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87012071.

This report describes HECTR Version 1.5N, which is a special version of HECTR developed specifically for application to the N Reactor. HECTR is a fast-running, lumped-parameter containment analysis computer program that is most useful for performing parametric studies. The main purpose of HECTR is to analyze nuclear reactor accidents involving the transport and combustion of hydrogen, but HECTR can also function as an experiment analysis tool and can solve a limited set of other types of containment problems. Version 1.5N is a modification of Version 1.5 and includes changes to the spray actuation logic, and models for steam vents, vacuum breakers, and building cross-vents. Thus, all of the key features of the N Reactor confinement can be modeled. HECTR is designed for flexibility and provides for user control of many important parameters, if built-in correlations and default values are not desired.

46983 **(SAND—87-0297) Compilation of network activity logs on a DECnet host.** George, M. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87014308.

Log files are created for all incoming connection requests on a DECnet host. These log files contain connection data such as the requesting source, destination, and throughput. The procedures (referred to as collect software) outlined in this report, were written to collect these log files, to extract the essential information, and to condense the data into one-line records. The two VAX/VMS systems at SNLA that currently run these procedures compile network transaction logs on a weekly basis. This document is intended for VAX/VMS system managers who wish to install, and possibly modify, this software.

46984 **(SAND—87-0452C) An embedded multiprocessor computer for proof-of-principle testing of exploratory systems concepts.** Borgman, C.R.; Dalton, L.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-8710105—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012735.

From 6. conference on computers in aerospace; Wakefield, MA, USA (7 Oct 1987).

This paper discusses the SANDAC V multiprocessor embedded computer hardware and software. Its expandable design provides adequate computing power for testing of various proof-of-principle (POP) exploratory system concepts. It is built from state-of-the-art integrated circuits with ASIC glue chips. A powerful software development system, multiprocessor on-board debugger, and a multitasking operating system kernel provide a user friendly software environment to complement the hardware.

46985 **(SAND—87-0700) NOSTRADAMUS programmable translator user's manual and programmer's manual.** Harmon, J.D. (RE/SPEC, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). Jul 1987. Contract AC04-76DP00789. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013414.

One of the disadvantages in using supercomputers to run engineering analysis codes is that the binary files produced on the supercomputer may be incompatible with postprocessing programs running on a different machine. It is therefore necessary to translate these binary files into a form that is readable by the machines used for postprocessing. Described herein is a programmable translator that translates data produced by one of these analysis codes from the binary format of the Cray supercomputer to the functional equivalent for the Digital Equipment Corporation VAX machines. The general usage of this translator is discussed, as well as the programming language for the translator and some of the finer points of the use of this language. Several programming examples are also included.

46986 **(SAND—87-1870C) QUICKSILVER: A 3D, electromagnetic, PIC code.** Seidel, D.B.; Kiefer, M.L.; Coats, R.S.; Siegel, A.L.; Quintenz, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870947—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87013013.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

QUICKSILVER is a multitasked, finite difference, 3-dimensional, fully relativistic, electromagnetic, particle-in-cell code currently under development at Sandia National Laboratories. It has been developed for current and near-term supercomputers, such as the Cray X-MP/416, which are characterized by large central memories and multiple processors. All grid-related quantities are stored in central memory and particle information may be stored out of memory if there is not sufficient central memory. The problem geometry is generated with a preprocessor and the simulation results are examined with a postprocessor. This report describes pre- and post-processing capabilities of Quicksilver and discusses algorithm development.

46987 **(SAND—87-1941C) Components and cycles of a random function.** DeLaurentis, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-870833—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87014155.

From Crypto '87; Santa Barbara, CA, USA (16 Aug 1987).

This investigation examines the average distribution of the components and cycles of a random function. Here we refer to the mappings from a finite set of, say, n elements into itself; denoted by

Γ/sub n/. Suppose the elements of Γ/sub n/ are assigned equal probability, i.e., P(γ) = n/sup -n/γ element of Γ/sub n/. The directed graph that is naturally associated with γ consists of several components, each with a unique cycle. Define X/sub n/(s,t)(γ) as the number of components in γ containing at least the fraction s of the total number of nodes, with the size of each component's cycle not exceeding tn/sup 1/2/. We derive an integral expression for the expected value of X/sub n/(s,t). The average number of components of a given size with cycles of a specified length approximately equals the volume under the graph of the integrand. This expression can be used to estimate the probability that a cycling experiment will detect a small cycle.

46988 **(SAND—87-7063) ESTIM: A parameter estimation computer program: Final report.** Hills, R.G. (New Mexico State Univ., Las Cruces (USA). Dept. of Mechanical Engineering). Aug 1987. Contract AC04-76DP00789. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87013977.

The computer code, ESTIM, enables subroutine versions of existing simulation codes to be used to estimate model parameters. Nonlinear least squares techniques are used to find the parameter values that result in a best fit between measurements made in the simulation domain and the simulation code's prediction of these measurements. ESTIM utilizes the non-linear least square code DQED (Hanson and Krogh [1982]) to handle the optimization aspects of the estimation problem. In addition to providing weighted least squares estimates, ESTIM provides a propagation of variance analysis. A subroutine version of COYOTE (Gartling [1982]) is provided. The use of ESTIM with COYOTE allows one to estimate the thermal property model parameters that result in the best agreement (in a least squares sense) between internal temperature measurements and COYOTE's predictions of these internal temperature measurements. We demonstrate the use of ESTIM through several example problems which utilize the subroutine version of COYOTE.

46989 **(SOL—87-7) Using MINOS [Modular In-core Nonlinear Optimization System] as a subroutine for decomposition.** Entriken, R. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jun 1987. Contract FG03-87ER25028. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87013086.

This report is intended to provide a detailed knowledge of how MINOS can be used as a subroutine to solve optimization subproblems. The subproblems can be tasks of a higher order decision making framework. The scope of this paper is limited to the case where the subproblems are linear programs. Extension to the nonlinear case would naturally follow the same line of work done for the linear case. The details of MINOS are presented in three parts: How MINOS Works, a general description of the modules of the MINOS package (each module is treated as a black box which performs some functions independent of the others), MINOS as a Subroutine, details how to set up the data structures of a subproblem in the proper format so that the optimization black box may solve it, and Decomposition with MINOS where nested-dual decomposition is used as a sophisticated example of how to create, modify and solve a sequence of different subproblems. This final part of the report is basically a description of a software package called DECOMP, which acts as a main program calling MINOS as a subroutine.

46990 **(SOL—87-9) The Box Method for linear programming: Part 2, Treatment of problems in standard form with explicitly bounded variables.** Zikan, K.; Cottle, R.W. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jul 1987. Contract FG03-87ER25028. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013072.

A crucial aspect of the Box Method for linear programming is the finding of a "minimum-weight basis" corresponding to a given interior feasible point. This subproblem leads to the formation of the "Box Problem," a special linear program having a closed form solution which provides the search direction at the current iteration. Finding a minimum-weight basis is a matroidal (or, combinatorial) optimization problem that can be handled by a greedy algorithm. This paper suggests a way of efficiently solving the minimum-weight basis problem in cases where the (primal, standard form) linear program contains explicitly bounded variables. It is shown that the main part of the task requires almost no more computational effort or storage space than does a problem of the same size without upper bounded variables. While this result is believed to be valuable in its own right, there is additional benefit to be gained in applications where the finding of a minimum-weight basis (for a linear program without explicit upper bounds on its variables) is done by a special greedy algorithm. Such is the case with minimum-cost network flow problems which will be discussed in Part III of this series.

46991 **(SOL—87-10) Computational behavior of Gauss-Newton methods.** Fraley, C. (Stanford Univ., CA (USA). Systems Optimization Lab.). Aug 1987. Contract FG03-87ER25030. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014486.

This paper is concerned with the numerical behavior of Gauss-Newton methods for nonlinear least-squares problems. Here we assume that the defining feature of a Gauss-Newton method is that the direction from one iterate to the next is the numerical solution of a particular linear least-squares problem, with a steplength subsequently determined by a linesearch procedure. It is well known that Gauss-Newton methods cannot be successfully applied to nonlinear least-squares problems as a class without modification. Our purpose is to give specific examples illustrating some of the difficulties that arise in practice which we believe have not been fully described in the literature.

46992 **(UCID—21056) Praxis: The programming language: An advanced overview.** Greenwood, J.R.; Holloway, F.W.; Morgan, C.R.; Evans, A. Jr. (Lawrence Livermore National Lab., CA (USA)). 6 Aug 1987. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014319.

Praxis is an Ada-like programming language developed for efficient programming of embedded control and systems applications. It is strongly typed, and block structured in the tradition of Pascal and Ada, with efficiency and control similar to C. Praxis supports the development of systems composed of separately compiled modules, user defined data types, exception handling, and detailed data storage and control mechanisms. Direct access to machine facilities, efficient bit manipulation, and interlocked critical regions are also provided in Praxis. Praxis has been in operational use since late 1980, and current implementations for the VAX, PDP and LSI-11 computers have been released into the public domain.

46993 **(UCID—21132) RANDOM NUMBER: A syntax-directed package to produce random numbers in user-specified, univariate distributions: User's guide.** Einwohner, T.H.; Shiflet, A.B. (Lawrence Livermore National Lab., CA (USA); Lander Coll., Greenwood, SC (USA)). [1987]. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014278.

Statistical simulations are an important tool in scientific work. They yield solutions to problems unobtainable by other means. Moreover, where alternative solutions are possible, statistical simulations often provide greater precision for the same computer cost. A statistical simulation requires the drawing of unbiased random numbers. And this simulation is made more efficient if unbiased, independent random numbers can be drawn from a preassigned distribution. Provided here is an easy-to-use computer program for drawing random numbers from a user-specified, univariate distribution. The user can specify the distribution by giving its algebraic form; conversion to a language like FORTRAN is unnecessary. Another motivation for this work is to develop a syntax-directed, expert system. This package is the first part of an expert system of Monte-Carlo techniques which will in turn become part of an extensive, artificial intelligence expert system hierarchy. This package will draw random numbers from any non-negative function with finite integral over its stated domain. It will decide from a syntactic analysis whether to use special tricks or general methods. Special tricks draw from power, exponential, or Gaussian distributions. Other special tricks allow random numbers to be drawn from sums of these distributions or in some cases linear combinations of

the above distributions. The general method used is the Rejection Method. The Bernstein Method is also available and suitable for tabular data.

46994 **(UCID—21143) BIMOND3: Monotone piecewise bicubic Hermite interpolation code.** Fritsch, F.N.; Carlson, R.E. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014612.

BIMOND3 is a Fortran program for interpolating bivariate data given on a rectangular mesh. The functional form is piecewise bicubic Hermite (PBH) on the data mesh. Subroutine PBHMD determines the Hermite derivatives so that the monotonicity of the interpolant matches that of the data. There is optional user control over boundary derivatives. Subroutine PBHEV evaluates a PBH function at an arbitrary point. It is used to evaluate the interpolant on a user-specific plotting mesh.

46995 **(UCID—21155) A shape preserving interpolant which has tension controls.** Foley, T.A. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 37p. NTIS, PC A03. File Number DE87014615.

The monotonicly and convexly constrained (MONCON) weighted v-spline interpolant is presented, which preserves local monotonicity and local convexity of the data. The MONCON weighted v-spline is the C^1 piecewise cubic, whose partition is defined by the data, that minimizes a variational problem subject to monotonicity and convexity constraints. The variational function that is minimized is the same as that minimized by the weighted v-spline, which is a generalization of the C^2 cubic spline, the weighted spline and the v-spline. By minimizing the constrained variational problem, the user not only generates a shape preserving interpolant, but the user can also interactively modify the shape of the curve using tension parameters and still preserve local monotonicity and convexity. An aspect of the work presented here that can apply to other methods is the definition of piecewise monotonicity constraints that vary continuously with respect to the data.

46996 **(UCRL—53808) QN3D: A three-dimensional quasi-neutral hybrid particle-in-cell code with applications to the tilt mode instability in field reversed configurations.** Horowitz, E.J. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1987. Contract W-7405-ENG-48. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87013409.

The tilt mode instability of a field reversed configurations (FRC) is discussed. Current numerical models do not properly explain the behavior of this mode. A particle-in-cell (PIC) model in cartesian coordinates is introduced with an explanation as to why it represents the physics of FRCs more closely. The model is presented by first simplifying Maxwell's equations using the Darwin limit. A final set of equations are derived by assuming the electrons to be an inertialess fluid with zero temperature. The PIC model is implemented in a FORTRAN code, QN3D. The major elements of this code are presented indicating the many techniques required for its optimization. Many of the major factors in optimization are dependent upon features of the Cray-2 Multiprocessor. Taking advantage of these new features is discussed in the text. Testing of the code is presented in three phases. First, single particle motion is analyzed. Next the normal modes are calculated and simulated. Finally, QN3D is applied to the rigid rotor problem. These tests indicate that the codes is suited to model plasma phenomena in the parameter regimes of interest. Lastly, two cases of the tilt mode problem are attempted. The results match current experiments and confirm initial hypothesis as to why other models are not adequate.

46997 **(UCRL—95810) A preliminary taxonomy of visible surface algorithms.** Grant, C.W. (California Univ., Davis (USA); Lawrence Livermore National Lab., CA (USA)). 10 Dec 1986. Contract W-7405-ENG-48. 5p. (CONF-8704194—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013559.

From Workshop on rendering algorithms and systems graphics; Toronto, Canada (5 Apr 1987).

Visibility determination is shown to be a common reoccurring subproblem in image synthesis. A preliminary taxonomy of visible surface algorithms is developed which is a superset of the taxonomy of Sutherland, Sproull, and Schumacker. Two major extensions are given. First, a three-dimensional structure based on sorting order is discovered for the point sampling class of algorithms. Second, an additional class of continuous sampling algorithms, not covered by Sutherland, Sproull, and Schumacker, is identified. Two main branches in this second class are identified, scan plane and subdivision algorithms.

46998 **(UCRL—95888) Differencing the diffusion equation on a mesh of triangles and quadrilaterals.** Zagotta, W.E.; Braddy, D.M. (Lawrence Livermore National Lab., CA (USA)). 6 Jan 1987. Contract W-7405-ENG-48. 9p. (CONF-8705169—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011550.

From Nuclear science and engineering conference; Paris, France (1 May 1987).

A finite differencing method has been derived, which is capable of solving the diffusion equation on a Lagrangian mesh consisting of an arbitrary mixture of quadrilaterals and triangles. Results have been presented that show that when run on similar problems, similar performance is achieved compared to other state-of-the-art codes.

46999 **(UCRL—95911) Unified sun and sky illumination for shadows under trees.** Max, N. (Lawrence Livermore National Lab., CA (USA)). 12 Jan 1987. Contract W-7405-ENG-48. 24p. (CONF-870738—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87014232.

From ACM SIGGRAPH conference; Anaheim, CA, USA (27 Jul 1987).

Assume the sun, sky and clouds are represented as a raster image on a plane at infinity, and the shadows of a tree canopy are represented as a raster transparency mask on a canopy plane. Then the illumination on the ground is the correlation of these two rasters, which can be rapidly computed by Fast Fourier Transform techniques.

47000 **(UCRL—96192) EAGLES: An interactive environment for scientific computing.** Lawver, B.S.; O'Brien, D.W.; Poggio, M.E.; Shectman, R.M. (Lawrence Livermore National Lab., CA (USA)). 11 May 1987. Contract W-7405-ENG-48. 5p. (CONF-870552—24). NTIS, PC A02. File Number DE87013564.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (11 May 1987).

The EAGLES Project is creating a computing system and interactive environment for scientific applications using object-oriented software principles. This software concept leads to well defined data interfaces for integrating experiments control with acquisition and analysis codes. Tools for building object-oriented systems for user interfaces and codes are discussed. Also the terms of object-oriented programming are introduced and later defined in the appendix. These terms include objects, methods, messages, encapsulation and inheritance.

47001 **Construction of variable-stepsize multistep formulas.** Skeel, R.D. (National Center for Atmospheric Research, Boulder, CO 80307). *Mathematics of Computation;* 47: No. 176, 503-510(Oct 1986).

A systematic way of extending a general fixed-stepsize multistep formula to a minimum storage variable-stepsize formula has been discovered that encompasses fixed-coefficient (interpolatory), variable-coefficient (variable step), and fixed leading coefficient as special cases. In particular, it is shown that the "interpolatory" stepsize changing technique of Nordsieck leads to a truly variable-stepsize multistep formula (which has implications for local error estimation and formula changing), and it is shown that the "variable-step" stepsize changing technique applicable to the Adams and backward-differentiation formulas has a reasonable generalization to the general multistep formula. In fact, it is shown how to construct a variable-order family of variable-coefficient formulas. Finally, it is observed that the first Dahlquist barrier does not apply to adaptable multistep methods if storage rather than stepnumber is the key consideration.

47002 **Numerical solution of second-order boundary value problems on nonuniform meshes.** Manteuffel, T.A.; White A.B. Jr. (National Center for Atmospheric Research, Boulder, CO 80307). *Mathematics of Computation;* **47**: No. 176, 511-535(Oct 1986).

In this paper, we examine the solution of second-order, scalar boundary value problems on nonuniform meshes. We show that certain commonly used difference schemes yield second-order accurate solutions despite the fact that their truncation error is of lower order. This result illuminates a limitation of the standard stability, consistency proof of convergence for difference schemes defined on nonuniform meshes. A technique of reducing centered-difference approximations of first-order systems to discretizations of the underlying scalar equation is developed. We treat both vertex-centered and cell-centered difference schemes and indicate how these results apply to partial differential equations on Cartesian product grids.

47003 **Supra-convergent schemes on irregular grids.** Kreiss, H.; Manteuffel, T.A.; Swartz, B.; Wendroff, B.; White, A.B. Jr. (National Center for Atmospheric Research, Boulder, CO 80307). *Mathematics of Computation;* **47**: No. 176, 537-554(Oct 1986).

As Tikhonov and Samarskii-breve showed for $k = 2$, it is not essential that kth-order compact difference schemes be centered at the arithmetic mean of the stencil's points to yield second-order convergence (although it does suffice). For stable schemes and even k, the main point is seen when the kth difference quotient is set equal to the value of the kth derivative at the middle point of the stencil; the proof is particularly transparent for $k = 2$. For any k, in fact, there is a [k/2]-parameter family of symmetric averages of the values of the kth derivative at the points of the stencil which, when similarly used, yield second-order convergence. The result extends to stable compact schemes for equations with lower-order terms under general boundary conditions. Although the extension of Numerov's tridiagonal scheme (approximating $D^2y = f$ with third-order truncation error) yields fourth-order convergence on meshes consisting of bounded number of pieces in which the mesh size changes monotonically, it yields only third-order convergence to quintic polynomials on any three-periodic mesh with unequal adjacent mesh sizes and fixes adjacent mesh ratios. A result of some independent interest is appended (and applied): it characterizes, simply, those functions of k variables which possess the property that their average value, as one translates over one period of an arbitrary periodic sequence of arguments, is zero; i.e., those bounded functions whose average value, as one translates over arbitrary finite sequences of arguments, goes to zero as the length of the sequences increases.

9903 Information Handling

REFER ALSO TO CITATION(S) 44928, 45049, 46922

47004 **(ANL/MCS-TM—94) Maintaining state constraints in relational databases: A proof theoretic basis.** McCune, W.W.; Henschen, L.J. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Jun 1987. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87014329.

If a relational database is required to satisfy a set of integrity constraints, then when the database is updated, one must ensure that it continues to satisfy the constraints. It is desirable not to have to evaluate each constraint after each update. A method is described that takes a constraint C and a class of updates, and either proves that an update in the class cannot violate the C, or produces a formula C′ (a complete test) that is satisfied before the update if and only if the C would continue to be satisfied were the update to occur. C′ is frequently much easier to evaluate than the C. In addition, a formula D (a sufficient test) is sometimes produced such that if D is satisfied before the update, then C would continue to be satisfied were the update to occur. The method is proved correct. The method is substantially more general than other reported techniques for this problem. The method has been implemented, and a number of experiments with the implementation are presented.

47005 **(CONF-870841—3) Knowledge acquisition issues encountered during the development of an estimating expert system.** Albright, K.; Emrich, M.L.; Sadlowe, A.R.; Arrowood, L.; Watson, B.D. (Oak Ridge National Lab., TN (USA)). 14 Aug 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87013320.

From 2. international conference on human-computer interaction; Honolulu, HI, USA (10 Aug 1987).

Artificial Intelligence, in particular expert systems methodologies, is being applied to the US Navy's automated data processing (ADP) project estimating tasks. Skilled Navy project leaders are nearing retirement and replacements may not possess the many years of experience required to make accurate estimating decisions of time, cost, equipment, and personnel needs. Knowledge acquisition has traditionally hindered the building of an expert system. A variety of information gathering techniques is discussed. Methods of interviewing, documenting, and verifying information are described. Project leaders were interviewed to capture their unique estimating expertise. Combining this information revealed fewer redundancies and contradictions than expected. The prototyping of the ADP-Estimator System is presented as part of the knowledge acquisition process.

47006 **(UCRL—93184) The influence of intelligent gateway systems on transborder data flow and international technology transfer.** Bollinger, W.A.; Fisher, H.L.; Gee, J.I.; Hampel, V.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1985. Contract W-7405-ENG-48. 13p. (CONF-8512127—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87012906.

From 9. international online information meeting; London, UK (3 Dec 1985).

New capabilities in communications technology cause strong differences of opinion in government and industry on how to control electronic data transmission of administrative, scientific, and technical data between countries. Regulations of transborder data flow (TDF) are further complicated by the unprecedented growth of information technology where the development of intelligent gateways and satellite networks span geographic and political boundaries. In this paper the present state of national policy and technology is examined, future trends are explored, and arguments to support opinions that intelligent gateways are the preferred tool for online database searching and analysis are presented. Beginning with an overview of present state-of-the-art systems, the effects of this new technology on transborder data flow are examined.

47007 **(UCRL—96717) Data structure and format conversion using syntactive inference.** Blattner, M.M.; Darmohray, G.A.; Burton, H.D. (California Univ., Davis (USA); Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 20p. (CONF-871088—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010874.

From COMPSAC '87; Tokyo, Japan (1 Oct 1987).

The provision of useful services and software tools for the users of on-line databases requires the restructuring and reformatting of downloaded information into a standard form. Developing database specific software to do this conversion is time-consuming and requires the services of a programmer/information specialist knowledgeable in the specific formats of the databases involved. In this paper a structure and format conversion tool for bibliographic citation databases that requires no knowledge beyond that of the citation organization in the system to be accessed is described. A user or an information specialist edits a carefully constructed sample provided by our service in the structure of the information to be downloaded. The restructuring and reformatting tool infers the citation structure and creates a grammar to be used by a parser for the translation process.

47008 **Lie-transformed Vlasov action principle: relativistically covariant wave propagation and self-consistent ponderomotive effects.** Kaufman, A.N.; Holm, D.D. (Lawrence Berkeley Lab., CA). *Physics Letters;* vp(Aug 1984). Contract AC03-76SF00098.

A bibliography of recent papers submitted and reports issued from Lawrence Berkeley Laboratory is presented. Subject areas in-

clude: high energy physics, nuclear physics, accelerators, biology, atomic physics and materials.

9904 Law

47009 **(IAEA-INFCIRC—336-Add.1) Convention on assistance in the case of a nuclear accident or radiological emergency.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 3p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87703052.

The document presents the status of signatures and notifications of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency which entered into force on 26 February 1987, i.e. thirty days after the date (26 January 1987) on which the third State expressed its consent to be bound by the Convention. The list of signature, notification, acceptance, approval or accession by States or Organizations is given.

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In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

DOE Energy Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC02-84ER60197	**Colorado Univ., Boulder, (USA). Cooperative Inst. for Research in Environmental Sciences**	
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AC05-76OR00033	**Oak Ridge Associated Universities, Inc., TN (USA)**	
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AC06-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
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AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)**	
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AC07-86ID12584	**UNC Geotech, Grand Junction, CO (USA)**	
	12:46186	DOE/ID/12584—6
AC08-83NV10282	**EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.**	
	12:45122	EGG—10282-1113
	12:45151	EGG—10282-1136
	EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations	
	12:46208	EGG—10282-2166
AC09-76SR00001	**Savannah River Lab., Aiken, SC (USA)**	
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	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
	12:46126	DP-MS—87-41
	South Carolina Univ., Columbia (USA). Dept. of Geography	
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AC21-83MC20230	**CNG Research Co., Pittsburgh, PA (USA)**	
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AC21-84MC21004	**Advanced Fuel Research, Inc., East Hartford, CT (USA)**	
	12:44840	DOE/MC/21004—2398
AC21-85MC22024	**Stearns Catalytic Corp., Denver, CO (USA)**	
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	12:44951	DOE/MC/22024—2339-Vol.3
	12:44952	DOE/MC/22024—2339-Vol.4
AC21-85MC22064	**Science Applications International Corp., Chatsworth, CA (USA)**	
	12:44841	DOE/MC/22064—2407
	12:44842	DOE/MC/22064—2408
AC21-86MC23136	**International Fuel Cells Corp., South Windsor, CT (USA)**	
	12:45595	DOE/MC/23136—2342
AC21-87MC23288	**City Coll., New York (USA)**	
	12:44843	DOE/MC/23288—2406
AC21-87MC23289	**UCC Research Corp., Bristol, VA (USA)**	
	12:44844	DOE/MC/23289—2409
AC22-83PC60050	**Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering**	
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	12:44846	DOE/PC/60050—7
AC22-84PC70771	**Energy and Environmental Research Corp., Irvine, CA (USA)**	
	12:45961	DOE/PC/70771—T6
AC22-85PC80015	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	12:45187	DOE/PC/80015—7
AC22-86PC90279	**Energy and Environmental Research Corp., Irvine, CA (USA)**	
	12:44955	DOE/PC/90279—T8
AI01-76ET20320	**Wichita State Univ., KS (USA)**	
	12:45299	DOE/NASA—3277-4
AI01-86CE50162	**Case Western Reserve Univ., Cleveland, OH (USA)**	
	12:45697	DOE/NASA—0030-2
AI05-86ER60390	**National Bureau of Standards, Washington, DC (USA)**	
	12:46277	DOE/ER/60390—T1
	National Bureau of Standards, Washington, DC (USA). Center for Radiation Research	
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AI07-80ID12138	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	12:46043	DOE/ID/12138—7
AI08-78ET44802	**Geological Survey, Denver, CO (USA)**	
	12:46336	USGS-OFR—87-80
AI79-83BP13076	**Montana Dept. of Fish, Wildlife and Parks, Missoula (USA)**	
	12:45225	DOE/BP/13076—2
AS03-76ET53064	**California Univ., Berkeley (USA). Electronics Research Lab.**	
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AS04-86AL38221	**Southern Univ., Baton Rouge, LA (USA). Dept. of Mechanical Engineering**	
	12:45694	DOE/AL/38221—T2
AS05-76ER03065	**Pennsylvania State Univ., University Park (USA)**	
	12:46660	DOE/ER/03065—T6
AS05-76ER04449	**Texas A and M Univ., College Station (USA)**	
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AS05-76ER05034	**Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy**	
	12:46643	DOE/ER/05034—10
AS05-78EV05888	**Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics**	
	12:46306	DOE/EV/05888—T3
AS05-80CS50028	**Miami Univ., Coral Gables, FL (USA)**	
	12:45696	DOE/CS/50028—T1
AS05-80ER10713	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
	12:46501	CONF-870797—1
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AS05-80ER10742	**Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439**	
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AT03-76EV70032	**Stanford Univ., CA (USA). Dept. of Pathology**	
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FC01-85EI19720	**Oregon State Dept. of Energy, Salem (USA)**	
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FC01-85EI19721	**New Hampshire Governor's Energy Office, Concord (USA)**	
	12:44989	DOE/EI/19721—T1
FC07-81ID12302	**Thermo Electron Corp., Waltham, MA (USA)**	
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FC07-81ID12303	**Aerojet Energy Conversion Co., Rancho Cordova, CA (USA)**	
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FC08-85DP40200	**Rochester Univ., NY (USA). Lab. for Laser Energetics**	
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FC21-83FE60177	**Western Research Inst., Laramie, WY (USA)**	
	12:44838	DOE/FE/60177—2413
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	12:45038	DOE/FE/60177—2401
	12:45039	DOE/FE/60177—2422
	12:45040	DOE/FE/60177—2423
	12:45041	DOE/FE/60177—2425
	12:45055	DOE/FE/60177—2417
	12:45056	DOE/FE/60177—2419
FC22-86PC90017	**Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research**	
	12:44852	DOE/PC/90017—T10
FG01-84CE50052	**Purdue Univ., Lafayette, IN (USA). School of Mechanical Engineering**	
	12:45695	DOE/CE/50052—H1

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FG01-85CE15231	**Reich (Douglas R.), North Fort Myers, FL (USA)**	
	12:45671	DOE/CE/15231—T6
FG01-85FE60765	**Southern States Energy Board, Atlanta, GA (USA)**	
	12:44962	DOE/FE/60765—T1
FG01-87CE15309	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering**	
	12:45222	DOE/CE/15309—T1
FG01-87CE15319	**Risberg Power Electronics, Inc., New Berlin, WI (USA)**	
	12:46028	DOE/CE/15319—T4
FG02-84ER13231	**Veterans Administration Medical Center, Omaha, NE**	
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FG02-84ER13290	**Delaware Univ., Newark (USA). Center for Catalytic Science and Technology**	
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FG02-84ER45116	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**	
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FG02-84ER45125	**Northwestern Univ., Evanston, IL**	
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FG02-84ER45130	**Washington Univ., St. Louis, MO**	
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FG02-84ER45170	**Univ. of Missouri, Kansas City**	
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FG02-85ER13323	**Pennsylvania State Univ., University Park (USA). Dept. of Chemistry**	
	12:45904	DOE/ER/13323—T1
FG02-85ER45189	**Michigan Univ., Ann Arbor (USA). Dept. of Physics**	
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FG02-85ER45199	**Purdue Univ., Lafayette, IN**	
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FG02-85ER45214	**Materials Research Laboratory and Department of Physics, Pennsylvania State University, University P**	
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FG02-85ER60316	**Univ. of Massachusetts, Amherst**	
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FG02-86ER13547	**Univ. of Wyoming, Laramie**	
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FG02-86ER13552	**Clarkson Univ., Potsdam, NY (USA). Dept. of Chemical Engineering**	
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FG02-86ER13569	**Rochester Univ., NY (USA)**	
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FG02-86ER13627	**Yale Univ., New Haven, CT (USA). Dept. of Biology**	
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FG02-86ER13630	**Kansas Univ., Lawrence (USA)**	
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FG02-86ER13640	**Northwestern Univ., Evanston, IL**	
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FG02-86ER45267	**Brown Univ., Providence, RI (USA)**	
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FG02-86ER52127	**Naval Surface Weapons Center, Silver Spring, MD (USA)**	
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FG02-86ER52128	**Wisconsin Univ., Madison (USA). Fusion Technology Inst.**	
	12:46907	DOE/ER/52128—1
FG02-86ER53222	**Columbia Univ., New York (USA). Plasma Physics Lab.**	
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FG02-86ER53223	**New York Univ., NY (USA). Courant Inst. of Mathematical Sciences**	
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FG02-87ER25026	**Illinois Univ., Urbana (USA). Dept. of Computer Science**	
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FG02-87ER40315	**Carnegie-Mellon Univ., Pittsburgh, PA (USA)**	
	12:46066	DOE/ER/40315—138
FG02-87ER40316	**Washington Univ., St. Louis, MO (USA). Dept. of Chemistry**	
	12:46645	DOE/ER/40316—1
FG02-87ER45310	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**	
	12:45717	DOE/ER/45310—4
FG03-85ER13336	**University of Southern California, Los Angeles (USA). Dept. of Geological Sciences**	
	12:46332	DOE/ER/13336—2
FG03-85ER25009	**California Inst. of Tech., Pasadena (USA)**	
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FG03-86ER53220	**California Univ., Berkeley (USA). Electronics Research Lab.**	
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FG03-87ER25028	**Stanford Univ., CA (USA). Systems Optimization Lab.**	
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FG03-87ER25030	**Stanford Univ., CA (USA). Systems Optimization Lab.**	
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FG05-80ET53088	**Texas Univ., Austin (USA)**	
	12:46419	DOE/ET/53088—288
	Texas Univ., Austin (USA). Inst. for Fusion Studies	
	12:46850	DOE/ET/53088—283
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FG05-84ER13281	**Texas Tech Univ., Lubbock**	
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FG05-84ER40159	**Louisiana State Univ., Baton Rouge, USA. Dept. of Physics; Oak Ridge Associated Universities, Inc.,**	
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FG05-85ER13339	**Meharry Medical College, Nashville, TN**	
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FG05-85ER53192	Auburn Univ., AL (USA). Dept. of Physics	
	12:46846	DOE/ER/53192—5
FG05-85ER60301	Maryland Univ., Frostburg (USA). Appalachian Environmental Lab.	
	12:46212	DOE/ER/60301—5
FG05-86ER45233	Rice Univ., Houston, TX (USA)	
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FG05-86ER45257	Georgia Inst. of Tech., Atlanta (USA). Fracture and Fatigue Research Lab.	
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FG05-87ER40309	Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.	
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FG05-87ER40319	Florida State Univ., Tallahassee (USA). Dept. of Physics	
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FG05-87ER60503	Louisiana State Univ., Baton Rouge (USA)	
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	Louisiana State Univ., Baton Rouge (USA). Dept. of Chemistry	
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FG09-85ER60311	Skidaway Inst. of Oceanography, Savannah, GA (USA)	
	12:46213	DOE/ER/60311—3
FG09-86SR15170	Claflin Coll., Orangeburg, SC (USA)	
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FG22-83PC60797	Southern Illinois Univ., Carbondale (USA). Dept. of Mechanical Engineering and Energy Processes	
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FG22-84PC70795	Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry	
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FG22-84PC70798	Utah Univ., Salt Lake City (USA)	
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FG22-84PC70799	Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)	
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FG22-84PC71257	Pittsburgh Univ., PA (USA)	
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FG22-85PC80511	Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering	
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FG22-85PC80516	Massachusetts Inst. of Tech., Cambridge (USA)	
	12:44850	DOE/PC/80516—8
FG22-85PC80519	New Mexico Univ., Albuquerque (USA). Powders and Granular Materials Lab.	
	12:44871	DOE/PC/80519—7
FG22-85PC80520	Rochester Univ., NY (USA). Dept. of Chemical Engineering	
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FG22-85PC80521	Duke Univ., Durham, NC (USA). Dept. of Chemistry	
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FG22-85PC80752	Brigham Young Univ., Provo, UT (USA). Combustion Lab.	
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FG22-85PC80906	SRI International, Menlo Park, CA (USA)	
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FG22-85PC80911	Rockwell International Corp., Thousand Oaks, CA (USA). Science Center	
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FG22-86PC90521	North Dakota Univ., Grand Forks (USA)	
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FG22-86PC90523	Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering	
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FG22-86PC90526	Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry	
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FG22-86PC90529	Brown Univ., Providence, RI (USA). Div. of Engineering	
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FG79-83BP35475	Idaho Dept. of Water Resources, Boise (USA)	
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W-31-109-ENG-38	International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors	
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W-7405-ENG-48	**Lawrence Livermore National Lab., CA (USA)**	
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5	*See* PNL-SA-13662	E 1.99: DE87012170	MN -34A	12:46429
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1	*See* IPPJ-DT-132	DE87702942	MN -20	12:46913
CONF-8602137-	(2. specialist research meeting on measurements of short-lived isotopes, Kumatori, Japan, 4-5 Feb 1986)			
	See KURRI-TR-277	DE87780156	MN -34C	12:46648
CONF-8602138-	(Symposium on fundamental problems in biological damage by radiation, Kumatori, Japan, 21-22 Feb 1986)			
	See KURRI-TR-279	DE87780157	MN -48	12:46293
CONF-8602145-	(Discussion meeting on determination of organic substances in precipitations, Neuherberg, F.R. Germany, 26 Feb 1986)			
	See GSF-BPT-10/86	DE87770272	MN -11	12:46165
CONF-860421-	(2. international conference on fusion reactor materials (ICFRM-2), Chicago, IL, USA, 13-17 Apr 1986)			
	J. Nucl. Mater., 148: No. 3, 279-287(May 1987)			12:45755
	J. Nucl. Mater., 148: No. 3, 288-293(May 1987)			12:45756
	J. Nucl. Mater., 148: No. 3, 294-301(May 1987)			12:45757
78	*See* HEDL-SA-3516	E 1.99: DE87011714	MN -20c	12:46912
79	*See* HEDL-SA-3422-FP	E 1.99: DE87014382	MN -79h	12:45425
80	*See* HEDL-SA-3496-FP	TI87014368	ND -20c	12:46911
CONF-8604352-	(Experts' meeting on agricultural uses of biogas, Vienna, Austria, 16 Apr 1986)			
Summs.	*See* IFU-B-14-86		ND -61	12:45191
CONF-860575-	(2. conference on particle and nuclear physics, Lake Louise, Canada, 26-31 May 1986)			
63	*See* DOE/ER/40150-6	E 1.99: DE87012464	MN -28	12:46056
CONF-8605284-	(4. seminar on the control of sulphur and nitrogen oxides from stationary sources, Graz, Austria, 12-16 May 1986)			
Summ.	*See* ECE-EB.AIR/SEM.1/R.30			12:44864
Summ.	*See* ECE-EB.AIR/SEM.1/R.9			12:44892

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Summ.	*See* ECE-EB.AIR/SEM.1/R.20			12:44895
Summ.	*See* ECE-EB.AIR/SEM.1/R.22			12:44896
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Summ.	*See* ECE-EB.AIR/SEM.1/R.75			12:46185
CONF-860605-	(13. international symposium on the effects of radiation on materials, Seattle, WA, USA, 23-25 Jun 1986)			
45	*See* HEDL-SA-3389-FP	E 1.99: DE87014365	MN -79b	12:45424
46	*See* HEDL-SA-3388-FP	E 1.99: DE87014366	MN -79b	12:45423
CONF-860611-	(5. international conference on phonon scattering in condensed matter, Urbana, IL, USA, 2-6 Jun 1986)			
1	*See* DOE/ER/03130-29	E 1.99: DE87014479	MN -34D	12:46109
CONF-860654-	(27. annual meeting of the Institute of Nuclear Materials Management, New Orleans, LA, USA, 22-25 Jun 1986)			
49	*See* HEDL-SA-3498-FP	E 1.99: DE87014363	MN -16	12:45160
CONF-8606215-	(Summer study on the physics of the superconducting super collider, Snowmass, CO, USA, 23 Jun-11 Jul 1986)			
44	*See* LBL-23573	DE87014022	MN -34D	12:46611
CONF-8606259-	(Theoretical Advanced Study Institute conference, Santa Cruz, CA, USA, 23 Jun-29 Jul 1986)			
3	*See* FNAL/C-86/146-A	E 1.99: DE87005400	MN -34B	12:46363
CONF-8606327-	(Seminar on software for diagnostic systems of nuclear power plants, Plzen, Czechoslovakia, 3-4 Jun 1986)			
	See INIS-mf-10947	DE87702905	MN -80	12:45398
CONF-8606328-	(8. international symposium on nuclear medicine, Karlovy Vary, Czechoslovakia, 2-5 Jun 1986)			
Absts.	*See* INIS-mf-10949	DE87702907	MN -48	12:46255
CONF-8606329-	(CERN school of physics, Sandhamn, Sweden, 8-21 Jun 1986)			
	See CERN-87-02	DE87703049	MN -34D	12:46553
CONF-8607190-	(Division of development and technology plasma/materials interaction and high heat flux materials and components task groups, Albuquerque, NM, USA, 9 Jul 1986)			
Summ.	NTIS, PC A13; 3	DE87013321	MN -20	12:46900
CONF-860880-	(30. SPIE technical symposium on optics and optoelectronic engineering, San Diego, CA, USA, 17-22 Aug 1986)			
55	*See* UCRL-95904	E 1.99: DE87011555	MN -34	12:46781
CONF-860891-	(Denver X-ray conference, Denver, CO, USA, 4-8 Aug 1986)			
3	*See* LBL-22170	E 1.99: DE87014079	MN -41	12:45976
4	*See* LBL-22169	E 1.99: DE87014080	MN -41	12:46294
CONF-8608121-	(11. international congress on X-ray optics and microanalysis, London, Canada, 4 Aug 1986)			
3	*See* BNL-40053	E 1.99: DE87013302	MN -28	12:46102

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CONF-8609142-	(Lattice gauge theory meeting, Upton, NY, USA, 15-19 Sep 1986)				
8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014139	MN -34D	12:46599
CONF-8609283-	(Workshop on vertex detectors: state of the art and perspectives, Erice, Italy, 21-26 Sep 1986)				
2	*See* SLAC-PUB-4285		DE87011590	MN -28	12:46119
CONF-8609310-	(11. meeting on linear accelerators, Oho, Japan, 1-3 Sep 1986)				
	See KEK-86-4		DE87703005	MN -28	12:46057
CONF-8609322-	(2. CRIEPI-EPRI workshop on energy analysis, Tokyo, Japan, 24-26 Sep 1986)				
Pt.1	*See* EY-86006			ND -97	12:45308
Pt.2	*See* EY-86007			ND -97	12:44964
CONF-8609330-	(Fossil plant inspections conference, San Antonio, TX, USA, 9-11 Sep 1986)				
	See EPRI-CS-5320		TI87920569	ND -101	12:45312
CONF-8610108-	(2. joint US/CERN school on particle accelerators: frontiers of particle beams, South Padre Island, TX, USA, 23-29 Oct 1986)				
3	*See* SLAC-PUB-4159	E 1.99:	DE87012840	MN -28	12:46089
4	*See* DOE/ER/40150-32	E 1.99:	DE87012466	MN -28	12:46081
CONF-8610115-	(4. international symposium on the production and neutralization of negative ions and beams, Upton, NY, USA, 27-31 Oct 1986)				
	AIP Conf. Proc., 158: No. 1, 404-418(30 Jul 1987)				12:46451
	AIP Conf. Proc., 158: No. 1, 507-517(30 Jul 1987)				12:46452
	AIP Conf. Proc., 158: No. 1, 520-533(30 Jul 1987)				12:46453
	AIP Conf. Proc., 158: No. 1, 536-546(30 Jul 1987)				12:46454
	AIP Conf. Proc., 158: No. 1, 631-642(30 Jul 1987)				12:46455
	AIP Conf. Proc., 158: No. 1, 643-650(30 Jul 1987)				12:46456
	AIP Conf. Proc., 158: No. 1, 663-672(30 Jul 1987)				12:46457
	AIP Conf. Proc., 158: No. 1, 673-681(30 Jul 1987)				12:46458
	See es Editor, AIP Conference Proceedings, American Institute of Physics, 335 E. 45th St., New York, NY 10017, $72.50		TI87014224		12:46474
	AIP Conf. Proc., 158: No. 1, 716-726(30 Jul 1987)				12:46935
CONF-8610281-	(Modern approaches to large nonlinear physical systems workshop, Santa Fe, NM, USA, 27-29 Oct 1986)				
1	*See* LA-UR-87-1627	E 1.99:	DE87010119	MN -34	12:46477
2	*See* LA-UR-87-2524	E 1.99:	DE87013167	MN -34	12:46479
CONF-8610325-	(Workshop on super massive blackholes, Fairfax, VA, USA, 14-16 Oct 1986)				
1	*See* UCRL-95413	E 1.99:	DE87013563	MN -34B	12:46382
CONF-861102-	(American Nuclear Society and Atomic Industrial Forum joint meeting, Washington, DC, USA, 16-21 Nov 1986)				
	Trans. Am. Nucl. Soc., 53: 512(1986)				12:45085
	Trans. Am. Nucl. Soc., 53: 512-514(1986)				12:45429
	Trans. Am. Nucl. Soc., 53: 306-307(1986)				12:45514
	Trans. Am. Nucl. Soc., 53: 359-360(1986)				12:45515
48	*See* HEDL-SA-3514-FP	E 1.99:	DE87014371	MN -79	12:45426
CONF-861114-	(9. international conference on application of accelerators in research and industry, Denton, TX, USA, 10-12 Nov 1986)				
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 38-42(Apr 1987)				12:46073
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 598-602(Apr 1987)				12:46094
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 391-396(Apr 1987)				12:46095
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 490-492(Apr 1987)				12:46096
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 598-602(Apr 1987)				12:46097
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 381-390(Apr 1987)				12:46100
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 59-63(Apr 1987)				12:46122
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 437-441(Apr 1987)				12:46137
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 69-73(Apr 1987)				12:46459
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 219-223(Apr 1987)				12:46460
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 284-287(Apr 1987)				12:46461
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 325-328(Apr 1987)				12:46462
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 1-2(Apr 1987)				12:46463
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	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 101-105(Apr 1987)			12:46465
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 106-110(Apr 1987)			12:46466
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 168-172(Apr 1987)			12:46467
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 209-213(Apr 1987)			12:46468
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 214-218(Apr 1987)			12:46469
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 256-260(Apr 1987)			12:46470
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 316-320(Apr 1987)			12:46471
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 69-73(Apr 1987)			12:46472
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 219-223(Apr 1987)			12:46473
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 447-453(Apr 1987)			12:46666
	Nucl. Instrum. Methods Phys. Res., Sect. A., 24/25: No. 1, 503-505(Apr 1987)			12:46681
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	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 397-399(Apr 1987)			12:46796
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 139-142(Apr 1987)			12:46797
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 147-152(Apr 1987)			12:46798
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 335-338(Apr 1987)			12:46799
	Nucl. Instrum. Methods Phys. Res., Sect. B, 24/25: No. 1, 373-376(Apr 1987)			12:46889
CONF-861124-	(Symposium on optical materials for high power lasers, Boulder, CO, USA, 3-5 Nov 1986)			
2	*See* UCRL-95283	E 1.99: DE87013106	MN -21	12:46929
CONF-8611178-	(5. conference on safety and pollution safeguards, Copenhagen, Denmark, 3-5 Nov 1986)			
Summ.	*See* NEI-DK-35	DE87752858	MN -64	12:46051
CONF-861220-	(American Geophysical Union fall meeting, San Francisco, CA, USA, 8-12 Dec 1986)			
7	*See* SAND-86-7134C	E 1.99: DE87010516	MN -70	12:45138
CONF-870116-	(International conference on stability of amorphous silicon alloy materials and devices, Palo Alto, CA, USA, 28-30 Jan 1987)			
	American Institute of Physics, 335 E. 45th Street, New York, NY 10017, $58.00	TI87012236		12:46038
CONF-870132-	(OE/LASE '87, Los Angeles, CA, USA, 11-16 Jan 1987)			
15	*See* BNL-39815	E 1.99: DE87012110	MN -38	12:45968
CONF-870170-	(Workshop on a linear-collider B anti B factory, Los Angeles, CA, USA, 26-30 Jan 1987)			
3	*See* SLAC-PUB-4159	E 1.99: DE87012840	MN -28	12:46089
4	*See* SLAC-PUB-4351	DE87013588	MN -28	12:46064
5	*See* SLAC-PUB-4366	E 1.99: DE87014314	MN -28	12:46099
CONF-870180-	(Workshop on physics at future accelerators, LaThuile, Italy, 7-10 Jan 1987)			
1-Summ.	*See* SLAC-PUB-4293	E 1.99: DE87012837	MN -28	12:46070
CONF-8702103-	(11. international colloquium on dynamics of explosions and reactive systems, Warsaw, Poland, 2-7 Feb 1987)			
1	*See* UCRL-95811	E 1.99: DE87010276	MN -34A	12:46780
CONF-870302-	(Particle accelerator conference, Washington, DC, USA, 16-19 Mar 1987)			
241	*See* UCRL-96384	DE87011556	MN -28	12:46092
245	*See* SLAC-PUB-4249	DE87013583	MN -28	12:46069
246	*See* UCRL-95419	DE87013492	MN -28	12:46009
247	*See* LBL-23232	E 1.99: DE87014021	MN -28	12:46060
CONF-870306-	(Waste management '87, Tucson, AZ, USA, 1-5 Mar 1987)			
64	*See* RHO-RE-SA-181-P	E 1.99: DE87010687	MN -70	12:45135
CONF-870309-	(United Nations conference for the promotion of international co-operation in the peaceful uses of nuclear energy, Geneva, Switzerland, 23 Mar-10 Apr 1987)			
	See INIS-mf-10955	DE87702908	MN -2	12:46949
CONF-870323-	(American Institute of Chemical Engineers spring national meeting, Houston, TX, USA, 29 Mar-2 Apr 1987)			
6	*See* DOE/ER/13552-1	E 1.99: DE87014008	MN -4	12:45853
CONF-870328-	(Joint symposium on stationary combustion NO/sub x/ control, New Orleans, LA, USA, 23-26 Mar 1987)			
Vol.1	*See* EPRI-CS-5361-Vol.1	TI87920561	ND -105	12:45322

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Vol.2	*See* EPRI-CS-5361-Vol.2	TI87920562	ND -105	12:45323
CONF-870381-	(Symposium on safeguards at Los Alamos: 20 years, Los Alamos, NM, USA, 5-6 Mar 1987)			
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 75-78(Jul 1987)			12:45084
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 79-82(Jul 1987)			12:45169
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 93-96(Jul 1987)			12:45170
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 99-104(Jul 1987)			12:45171
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 22(Jul 1987)			12:45172
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 37-38(Jul 1987)			12:45173
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 39-42(Jul 1987)			12:45174
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 43-49(Jul 1987)			12:45175
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 50-52(Jul 1987)			12:45176
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 61-63(Jul 1987)			12:45177
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 64-67(Jul 1987)			12:45178
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 68-70(Jul 1987)			12:45179
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 71-74(Jul 1987)			12:45180
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 83-87(Jul 1987)			12:45874
	J. Inst. Nucl. Mater. Manage., 15: No. 4, 88-92(Jul 1987)			12:45875
CONF-870390-	(22. Recontres de Moriond: electroweak interactions and unified theories conference, Les Arcs, France, 8-15 Mar 1987)			
10	*See* SLAC-PUB-4336	DE87013585	MN -34D	12:46512
CONF-8703121-	(Telemark IV - neutrino mass and neutrino astrophysics, Ashland, WI, USA, 16-18 Mar 1987)			
5	*See* DOE/ER/03130-32	E 1.99: DE87014477	MN -34B	12:46110
CONF-8703127-	(4. international technical symposium on optical and electro-optical applied science and engineering, Hague, Netherlands, 30 Mar-3 Apr 1987)			
2	*See* UCRL-95307	DE87013107	MN -37	12:46124
CONF-8703149-	(Workshop on low emittance beams, Upton, NY, USA, 1 Mar 1987)			
4	*See* LBL-23484	E 1.99: DE87012890	MN -28	12:46068
5	*See* LBL-23426	E 1.99: DE87014127	MN -34A	12:46426
CONF-8703159-	(13. annual convention of the Eastern Economic Association, Washington, DC, USA, 5-7 Mar 1987)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011514	MN -121	12:44987
CONF-8703162-	(European meeting on positron studies of defects, Wernigerode, German D.R., 23-27 Mar 1987)			
	See PSD-87	DE87703128	MN -34A	12:46743
CONF-8703165-	(Workshop on propagative nonequilibrium patterns, Les Houches, France, 1 Mar 1987)			
1	*See* LA-UR-87-2554	E 1.99: DE87013173	MN -34	12:46480
CONF-8703169-	(Workshop on experiments and experimental facilities at SIS/ESR, Darmstadt, F.R. Germany, 30 Mar-1 Apr 1987)			
Absts.	*See* GSI-87-7		ND -34C	12:46646
CONF-8703176-	(Workshop on low temperature detectors for low energy neutrinos and dark matter, Munich, F.R. Germany, 12-13 Mar 1987)			
1	*See* DOE/ER/03130-33	E 1.99: DE87014476	MN -34D	12:46111
CONF-870405-	(Topical conference on theory and practice in radiation protection and shielding, Knoxville, TN, USA, 22-24 Apr 1987)			
16	*See* HEDL-SA-3569-FP	E 1.99: DE87014378	MN -79	12:45483
CONF-870413-	(11. international conference on particles and nuclei, Kyoto, Japan, 20-24 Apr 1987)			
7	*See* BNL-40007	E 1.99: DE87013300	MN -28	12:46053
8-Prepr.	*See* GSI-87-26-Prepr.		ND -34A	12:46420
9	*See* BNL-40139	E 1.99: DE87014285	MN -34D	12:46490
CONF-870418-	(Topical meeting on anticipated and abnormal transients in nuclear power plants, Atlanta, GA, USA, 12-15 Apr 1987)			
3-FP	NTIS, PC A02; 3	DE87011532	MN -79	12:45391
CONF-870444-	(16. international technical meeting on air pollution modelling and its application, Lindau, F.R. Germany, 6-10 Apr 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011522	MN -11	12:46162

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CONF-870466-	(International conference on environmental degradation of engineering materials, University Park, PA, USA, 13-15 Apr 1987)			
3	*See* UCRL-94146	E 1.99: DE87009598	MN -25	12:45822
CONF-870498-	(7. tandem conference, Berlin, F.R. Germany, 6-10 Apr 1987)			
9	*See* BNL-39976	E 1.99: DE87012872	MN -28	12:46076
CONF-8704110-	(5. geothermal program review, Washington, DC, USA, 14-15 Apr 1987)			
14	*See* SAND-87-0918C	E 1.99: DE87013470	MN -11	12:46049
CONF-8704118-	(TIBER meetings, Livermore, CA, USA, 6-8 Apr 1987)			
2-Vugraphs	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011652	MN -20	12:46901
CONF-8704135-	(Annual heat engine and gas stream cleanup contractors review meeting, Morgantown, WV, USA, 21-23 Apr 1987)			
	See DOE/METC-87/6077	E 1.99: DE87001072	MN -103	12:45310
CONF-8704152-	(Workshop on tests of time reversal invariance in neutron physics, Chapel Hill, NC, USA, 17-19 Apr 1987)			
2	*See* LA-UR-87-2574	E 1.99: DE87013176	MN -34D	12:46592
CONF-8704168-	(Workshop on particle methods in fluid dynamics and plasma physics, Los Alamos, NM, USA, 13-15 Apr 1987)			
1	*See* LA-UR-87-1862	E 1.99: DE87011794	MN -34	12:46478
CONF-8704170-	(International conference on plasma physics, Kiev, USSR, 6-12 Apr 1987)			
2	*See* DOE/ET/53088-293	E 1.99: DE87014425	MN -20a	12:46854
3	*See* DOE/DP/40200-53	E 1.99: DE87014466	MN -21	12:46906
CONF-8704171-	(International symposium on magnetism of intermetallic compounds, Kyoto, Japan, 20-22 Apr 1987)			
2	*See* BNL-40024	E 1.99: DE87013305	MN -34A	12:46724
CONF-8704177-	(2. international conference on hadron spectroscopy, Tsukuba, Japan, 16-18 Apr 1987)			
5	*See* SLAC-PUB-4360	DE87014312	MN -34D	12:46514
CONF-8704181-	(Israel Health Physics Society annual meeting, Tel-Aviv, Israel, 22-23 Apr 1987)			
	See INIS-mf-10946	DE87780161	MN -4	12:46287
CONF-8704183-	(4. TWP meeting, Naka, Japan, 13 Apr 1987)			
1-Vugraphs	NTIS, PC A03; 3	DE87009124	MN -20	12:46902
CONF-8704194-	(Workshop on rendering algorithms and systems graphics, Toronto, Canada, 5-6 Apr 1987)			
1	*See* UCRL-95810	E 1.99: DE87013559	MN -32	12:46997
CONF-8704195-	(1. Carver Research Foundation conference on issues pertinent to radioactive waste processing, management and disposal, Tuskegee, AL, USA, 3 Apr 1987)			
1	*See* PNL-SA-14822-S	E 1.99: DE87012174	MN -85	12:45091
CONF-870505-	(32. international gas turbine conference and exhibition, Anaheim, CA, USA, 31 May-4 Jun 1987)			
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45315
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45316
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45317
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45318
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45319
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45320
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45347
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45702
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45703
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45760
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45790
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45791
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:45792
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:46019
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:46046
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:46047
	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			12:46048

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CONF-870528-	(19. IEEE photovoltaic specialists conference, New Orleans, LA, USA, 4-8 May 1987)			
19	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014307	MN -63	12:45228
CONF-870543-	(2. workshop on experiments and detectors for relativistic heavy ion collider, Berkeley, CA, USA, 25-29 May 1987)			
2	*See* BNL-40075	E 1.99: DE87013312	MN -34D	12:46544
5	*See* BNL-40123	E 1.99: DE87014286	MN -37	12:46104
CONF-870552-	(5. conference on real-time computer applications in nuclear, particle, and plasma physics, San Francisco, CA, USA, 11-15 May 1987)			
21	*See* GA-A-18862	E 1.99: DE87012037	MN -20	12:46909
23	*See* FNAL/C-87/93	DE87013565	MN -32	12:46968
24	*See* UCRL-96192	DE87013564	MN -32	12:47000
CONF-870558-	(19. international electric propulsion conference, Colorado Springs, CO, USA, 11-13 May 1987) Colorado Springs, CO; AIAA (1987).			12:45995
CONF-870584-	(Society of Photo-Optical Instrumentation Engineers conference, Orlando, FL, USA, 17-22 May 1987)			
11	*See* LA-UR-87-2465	E 1.99: DE87013165	MN -37	12:45812
CONF-8705162-	(Spent fuel storage technical exchange meeting, Washington, DC, USA, 12-13 May 1987)			
Vugraphs	*See* PNL-SA-15094	E 1.99: DE87012683	MN -85	12:45092
CONF-8705163-	(From colliders to supercolliders workshop, Madison, WI, USA, 11-22 May 1987)			
3	*See* SLAC-PUB-4350	DE87013587	MN -34D	12:46513
5	*See* LBL-23633	E 1.99: DE87014119	MN -34C	12:46564
6	*See* SLAC-PUB-4369	DE87014315	MN -34D	12:46565
CONF-8705164-	(Distribution/transmission conference, Las Vegas, NV, USA, 4-6 May 1987)			
1	*See* LBL-23500	E 1.99: DE87012030	MN -131	12:45016
CONF-8705168-	(Workshop on competing interactions and microstructures: statics and dynamics, Los Alamos, NM, USA, 5-8 May 1987)			
1	*See* BNL-40069	DE87013316	MN -34	12:46725
CONF-8705169-	(Nuclear science and engineering conference, Paris, France, 1 May 1987)			
2	*See* UCRL-95888	E 1.99: DE87011550	MN -32	12:46998
CONF-8705172-	(18. European conference on laser interaction with matter, Prague, Czechoslovakia, 4 May 1987)			
1	*See* UCRL-95981	E 1.99: DE87013483	MN -21	12:46931
CONF-8705173-	(NATO ASI meeting on organic and inorganic low dimensional crystalline materials, Minorca-Beleares, Spain, 3-8 May 1987)			
1	*See* BNL-40013	E 1.99: DE87012864	MN -34A	12:46804
CONF-8705186-	(3. European congress of the Institution of Mechanical Engineers, Hague, Netherlands, 18-20 May 1987) *See* IMechE-1987-4		ND -38	12:45970
CONF-870609-	(American industrial hygiene conference, Montreal, Canada, 1 Jun 1987)			
3	*See* UCRL-95544	E 1.99: DE87012911	MN -20e	12:46930
CONF-870610-	(5. national synchrotron radiation instrumentation conference, Madison, WI, USA, 21-25 Jun 1987)			
4	*See* BNL-39920	E 1.99: DE87012118	MN -28	12:46075
9	*See* BNL-40055	E 1.99: DE87013301	MN -28	12:46098
10	*See* LBL-23616	E 1.99: DE87014132	MN -37	12:46130
CONF-870622-	(19. fluid dynamics, plasma dynamics, and laser conference, Honolulu, HI, USA, 8-10 Jun 1987)			
8	*See* LA-UR-87-1242	E 1.99: DE87011795	MN -28	12:46059
CONF-870631-	(8. US symposium on compact toroid research and the 9. US/Japan workshop on compact toroids, College Park, MD, USA, 4-5 Jun 1987)			
3	*See* DOE/ER/52127-14	E 1.99: DE87013014	MN -20	12:46845
4	*See* UCRL-96828	E 1.99: DE87012176	MN -20	12:46873
CONF-870632-	(International Europhysics conference on high energy physics, Uppsala, Sweden, 25 Jun-1 Jul 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014138	MN -34D	12:46598
CONF-870633-	(4. workshop on nonlinear evolution equations and dynamical systems, Montpellier, France, 11-15 Jun 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013541	MN -32	12:46960
CONF-870644-	(78. annual meeting of the American Society of Biological Chemists conference, Philadelphia, PA, USA, 7-11 Jun 1987)			
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1996(1 May 1987)			12:46242
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1996(1 May 1987)			12:46243
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1973(1 May 1987)			12:46244
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1970(1 May 1987)			12:46245
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1970(1 May 1987)			12:46246

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	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1976(1 May 1987)				12:46247
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1976(1 May 1987)				12:46248
	Fed. Proc., Fed. Am. Soc. Exp. Biol., 46: No. 6, 1948(1 May 1987)				12:46320
CONF-870656-	(6. Institute of Electrical and Electronic Engineers pulsed power conference, Arlington, VA, USA, 29 Jun-1 Jul 1987)				
1-FP	*See* SAND-87-0140C-FP		DE87011854	MN -21	12:46918
36	*See* SAND-86-2660C		DE87012131	MN -28	12:46084
37	*See* SAND-87-0082C		DE87012132	MN -28	12:46062
39	*See* SAND-87-0129C		DE87012021	MN -28	12:46063
42	*See* SAND-87-0114C		DE87012402	MN -28	12:46085
43	*See* SAND-87-0137C	E 1.99:	DE87012359	MN -28	12:46086
45	*See* UCRL-96263		DE87014346	MN -38	12:46010
46	*See* UCRL-96264		DE87014347	MN -38	12:46036
CONF-870659-	(7. annual gasification systems conference, Morgantown, WV, USA, 16-19 Jun 1987)				
4	*See* BNL-39986	E 1.99:	DE87014394	MN -109	12:44821
CONF-870679-	(5. symposium on energy engineering sciences, Argonne, IL, USA, 17-19 Jun 1987)				
3	*See* EGG-M-16687	E 1.99:	DE87012425	MN -38	12:46022
CONF-870682-	(Workshop on novel mechanisms for superconductivity, Berkeley, CA, USA, 22-25 Jun 1987)				
3	*See* LBL-23692	E 1.99:	DE87012818	MN -25	12:45813
CONF-870695-	(80. annual meeting of the Air Pollution Control Association, New York, NY, USA, 1 Jun 1987)				
9	*See* LBL-23078	E 1.99:	DE87014020	MN -11	12:46166
CONF-8706101-	(American Solar Energy Society annual meeting, Portland, OR, USA, 1 Jun 1987)				
1	*See* SAND-87-0162C-FP	E 1.99:	DE87009061	MN -63	12:45254
CONF-8706113-	(6. Adriatic international conference on nuclear physics, Dubrovnik, Yugoslavia, 15-19 Jun 1987)				
5	*See* UCRL-97262	E 1.99:	DE87014353	MN -34C	12:46694
CONF-8706119-	(Workshop on alpha particle effects in ETR, Washington, DC, USA, 15-16 Jun 1987)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011677	MN -20f	12:46842
CONF-8706125-	(Conference on advances in cryogenic engineering, St. Charles, IL, USA, 14-18 Jun 1987)				
7	*See* BNL-39943		DE87012115	MN -38	12:45969
CONF-8706128-	(8. international conference on laser spectroscopy, Are, Sweden, 22-26 Jun 1987)				
3	*See* LBL-23676	E 1.99:	DE87014081	MN -34A	12:46742
CONF-8706147-	(Workshop on new developments in particle acceleration techniques, Orsay, France, 29 Jun-4 Jul 1987)				
2	*See* UCRL-96947	E 1.99:	DE87013562	MN -28	12:46093
3	*See* SLAC-PUB-4375	E 1.99:	DE87014317	MN -28	12:46090
4	*See* UCRL-96843	E 1.99:	DE87013784	MN -28	12:46072
CONF-8706157-	(23. AIAA/SAE/ASME/ASEE joint propulsion conference, San Diego, CA, USA, 29 Jun-2 Jul 1987)				
1	*See* LA-UR-87-2017	E 1.99:	DE87011772	MN -38	12:45698
CONF-8706166-	(International symposium on medium energy physics, Beijing, China, 23-27 Jun 1987)				
2	*See* BNL-40074	E 1.99:	DE87014283	MN -34C	12:46654
CONF-8706176-	(Workshop and symposium on the physics of low energy, stored, and trapped particles, Stockholm, Sweden, 14-18 Jun 1987)				
2	*See* LA-UR-87-2386	E 1.99:	DE87013159	MN -34D	12:46828
CONF-8706178-	(International symposium on AI, expert systems and languages in modelling and simulation, Barcelona, Spain, 2-4 Jun 1987)				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013336	MN -32	12:46963
CONF-8706181-	(4. Deutsche Forschungs-und Verschesanstalt Fur Fult-und Raumfahart conference, Koln, F.R. Germany, 25-26 Jun 1987)				
1	*See* UCRL-96835	E 1.99:	DE87013510	MN -34	12:46481
CONF-8706182-	(All-Union symposium on physics of nuclear fission, Obninsk, USSR, 2-5 Jun 1987)				
2-Prepr.	*See* GSI-87-24-Prepr.			ND -34C	12:46687
CONF-8706184-	(TIBER II review meeting, Oak Ridge, TN, USA, 16-17 Jun 1987)				
1-Vugraphs	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013546	MN -20	12:46903
2-Vugraphs	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013547	MN -20	12:46904
CONF-8706185-	(Charm physics symposium, Beijing, China, 4-16 Jun 1987)				
1	*See* SLAC-PUB-4352		DE87013589	MN -34D	12:46612
CONF-8706189-	(International symposium on the mathematics of newworks and systems, Phoenix, AZ, USA, 18 Jun 1987)				
1	*See* SAND-87-1494C	E 1.99:	DE87014192	MN -38	12:46035
CONF-870705-	(Annual meeting of the Health Physics Society, Salt Lake City, UT, USA, 5-9 Jul 1987)				
3	*See* BNL-39931	E 1.99:	DE87014294	MN -48	12:46710

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CONF-870711-	(Solar '87: 12th national passive solar conference, Portland, OR, USA, 12-16 Jul 1987)			
2-FP	*See* SAND-87-0162C-FP	E 1.99: DE87009061	MN -63	12:45254
CONF-870713-	(28. INMM annual meeting on safeguards: a mature technology, Newport Beach, CA, USA, 12-15 Jul 1987)			
28	*See* DP-MS-87-41	E 1.99: DE87012390	MN -37	12:46126
46	*See* UCRL-96932	DE87013485	MN -15	12:45168
49	*See* BNL-40059	DE87013309	MN -15	12:45157
50	*See* LA-UR-87-2242	DE87013134	MN -15	12:45162
52	*See* LA-UR-87-2243	E 1.99: DE87013135	MN -15	12:45163
53	*See* SAND-87-1917C	DE87014159	MN -71	12:45109
55	*See* BNL-40118	DE87014287	MN -16	12:45159
56	*See* BNL-40063	DE87014289	MN -16	12:45158
CONF-870715-	(15. international conference on the physics of electronic and atomic collisions, Brighton, UK, 22-28 Jul 1987)			
3	*See* UCRL-96217	E 1.99: DE87013229	MN -34A	12:46433
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87013179	MN -34A	12:46407
CONF-870724-	(24. annual conference on nuclear and space radiation in electronics, Snowmass, CO, USA, 28-31 Jul 1987)			
17	*See* SAND-87-1615C	E 1.99: DE87012400	MN -37	12:46123
CONF-870733-	(Pacific workshop and meeting on analytical electron microscopy, Kona, HI, USA, 12-17 Jul 1987)			
4	*See* SAND-87-1773C	E 1.99: DE87012129	MN -34A	12:46778
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013551	MN -34A	12:46726
CONF-870738-	(ACM SIGGRAPH conference, Anaheim, CA, USA, 27-31 Jul 1987)			
3	*See* UCRL-95911	E 1.99: DE87014232	MN -32	12:46999
CONF-870739-	(Workshop on experiments, detectors, and experimental areas for the supercollider, Berkeley, CA, USA, 7-17 Jul 1987)			
1	*See* BNL-40203	E 1.99: DE87014427	MN -34D	12:46545
CONF-870747-	(10. discussion conference on small-angle scattering and related methods, Prague, Czechoslovakia, 13-16 Jul 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012936	MN -25	12:45806
CONF-870753-	(5. topical conference of the American Physical Society on shockwaves in condensed matter, Monterey, CA, USA, 20-23 Jul 1987)			
22	*See* SAND-87-0315C	E 1.99: DE87012362	MN -38	12:45735
24	*See* SAND-87-1244C	E 1.99: DE87012361	MN -38	12:46151
27	*See* SAND-87-0954C	E 1.99: DE87012737	MN -34	12:46381
46	*See* LA-UR-87-2367	DE87013157	MN -34	12:46978
49	*See* UCRL-96553	DE87013220	MN -34A	12:46785
52	*See* SAND-87-1006C	E 1.99: DE87013447	MN -38	12:45986
53	*See* UCRL-96528	DE87013490	MN -34A	12:46784
56	*See* UCRL-96492	DE87013109	MN -34A	12:46783
57	*See* SAND-87-0725C	E 1.99: DE87013067	MN -38	12:46024
59	*See* LA-UR-87-2283	DE87013141	MN -34	12:46739
60	*See* LA-UR-87-2272	E 1.99: DE87013138	MN -34	12:46737
61	*See* LA-UR-87-2273	E 1.99: DE87013139	MN -34	12:46738
62	*See* LA-UR-87-2260	E 1.99: DE87013137	MN -25	12:45728
66	*See* SAND-87-0768C	E 1.99: DE87013937	MN -25	12:45736
67	*See* UCRL-96497	E 1.99: DE87013796	MN -4	12:46153
68	*See* UCRL-96768	E 1.99: DE87013797	MN -25	12:45823
69	*See* UCRL-96479	E 1.99: DE87011876	MN -38	12:45988
70	*See* SAND-87-0927C	E 1.99: DE87014216	MN -45	12:46150
CONF-870759-	(5. international swarm seminar, Birmingham, UK, 29-31 Jul 1987)			
2	NTIS, PC A02; 3	DE87010395	MN -34A	12:46408
CONF-870762-	(Coatings for advanced heat engines workshop, Castine, ME, USA, 27-30 Jul 1987)			
Absts.	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87012623	MN -96	12:45693
CONF-870774-	(7. electronic properties of two-dimensional systems, Santa Fe, NM, USA, 27-31 Jul 1987)			
1	*See* LA-UR-87-1910	E 1.99: DE87011790	MN -34	12:46736
CONF-870784-	(NATO workshop on atomic and molecular processes with short intense laser pulse, Sherbrooke, Canada, 19-24 Jul 1987)			
1	*See* LA-UR-87-2311	E 1.99: DE87013147	MN -34A	12:46424
2	*See* UCRL-96942	E 1.99: DE87013792	MN -34	12:46435
CONF-870785-	(Adriatico Research conference on vacuum in nonrelativistic matter-radiation systems, Trieste, Italy, 1 Jul 1987)			
1	*See* LA-UR-87-2315	E 1.99: DE87013150	MN -34A	12:46827
CONF-870788-	(Meeting on atomic and molecular data for plasma edge studies, Vienna, Austria, 8-10 Jul 1987)			
1-Summ.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012928	MN -20g	12:46841
CONF-870789-	(International conference on multiphoton processes, Boulder, CO, USA, 13-17 Jul 1987)			
1	*See* LA-UR-87-2322	E 1.99: DE87013152	MN -34	12:46425
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012530	MN -34A	12:46409

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CONF-870790-	(1. European workshop on high T/sub c/ superconductors and potential applications, Genova, Italy, 1 Jul 1987)			
1	*See* LA-UR-87-2537	DE87013170	MN -34	12:46806
CONF-870797-	(International symposium for lepton and photon interactions at high energy, Hamburg, F.R. Germany, 27-31 Jul 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014183	MN -34D	12:46501
CONF-870799-	(American conference on crystal growth, Monterey, CA, USA, 13-17 Jul 1987)			
1	*See* UCRL-96019	E 1.99: DE87014246	MN -34	12:46782
CONF-870802-	(194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug-4 Sep 1987)			
10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014406	MN -4	12:45852
13	*See* DP-MS-87-27	E 1.99: DE87012920	MN -4	12:45118
14-Rev.1	*See* DP-MS-87-32-Rev.1	E 1.99: DE87014197	MN -70	12:45119
CONF-870804-	(22. intersociety energy conversion engineering conference, Philadelphia, PA, USA, 10-14 Aug 1987)			
30	*See* GA-A-18860	DE87013932	MN -77	12:45345
CONF-870812-	(9. SMIRT: international conference on structural mechanics in reactor technology, Lausanne, Switzerland, 17-21 Aug 1987)			
	See NUREG/CP-0088	TI87900888	MN -78	12:45495
29	*See* GA-A-18870	E 1.99: DE87013998	MN -77	12:45346
CONF-870820-	(PSA 87: international topical meeting on probabilistic safety assessment and risk management, Zurich, Switzerland, 31 Aug-4 Sep 1987)			
7	*See* GA-A-18930	E 1.99: DE87013933	MN -77	12:45481
CONF-870830-	(AIAA aerodynamics flight mechanics conference, Monterey, CA, USA, 17-19 Aug 1987)			
7	*See* SAND-87-0118C	DE87013726	MN -38	12:45983
CONF-870832-	(Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry, Snowbird, UT, USA, 31 Aug-2 Sep 1987)			
1	*See* DOE/NE/37959-9	E 1.99: DE87014227	MN -80	12:45383
2-Draft	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014414	MN -38	12:46961
CONF-870833-	(Crypto '87, Santa Barbara, CA, USA, 16-20 Aug 1987)			
3	*See* SAND-87-1941C	E 1.99: DE87014155	MN -32	12:46987
4	*See* SAND-87-1354C	E 1.99: DE87014215	MN -13	12:45167
CONF-870841-	(2. international conference on human-computer interaction, Honolulu, HI, USA, 10-15 Aug 1987)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013320	MN -32	12:47005
CONF-870859-	(9. annual low-level radioactive waste management program conference, Denver, CO, USA, 25-27 Aug 1987)			
2-Summ.	*See* DP-MS-87-87	E 1.99: DE87012385	MN -70B	12:45121
9	*See* DP-MS-87-80	E 1.99: DE87014201	MN -70B	12:45120
CONF-870863-	(Seminar on small and medium-sized nuclear reactors: safety and licensing issues, Lausanne, Switzerland, 24-26 Aug 1987)			
3	*See* GA-A-18888	E 1.99: DE87013934	MN -77	12:45480
CONF-870873-	(18. conference on low temperature physics, Kyoto, Japan, 20-26 Aug 1987)			
11	*See* SAND-87-2044C	E 1.99: DE87014156	MN -34	12:46807
CONF-870875-	(Solar thermal technology conference, Albuquerque, NM, USA, 26-27 Aug 1987)			
Absts.	*See* SAND-87-1258	E 1.99: DE87014441	MN -62	12:45258
CONF-870893-	(6. international conference on rapidly quenched metals, Montreal, Canada, 3-7 Aug 1987)			
4	*See* UCRL-96446	E 1.99: DE87014250	MN -25	12:45739
CONF-8708101-	(6. international symposium on capture gamma-ray spectroscopy, Leuven, Belgium, 31 Aug-4 Sep 1987)			
4	*See* BNL-40149	E 1.99: DE87014391	MN -34C	12:46684
5	*See* UCRL-95966	E 1.99: DE87014341	MN -34C	12:46679
6	*See* BNL-40157	E 1.99: DE87014396	MN -34C	12:46655
7	*See* BNL-40150	E 1.99: DE87014390	MN -34C	12:46685
8	*See* BNL-40142	E 1.99: DE87014393	MN -34C	12:46683
CONF-8708102-	(Pion nucleus physics: future directions and new facilities at LAMPF workshop, Los Alamos, NM, USA, 17-21 Aug 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014042	MN -34C	12:46686
CONF-8708105-	(34. IUPAC General Assembly, Boston, MA, USA, 21-29 Aug 1987)			
2	*See* BNL-NCS-39949	E 1.99: DE87012867	MN -34A	12:46159
CONF-8708106-	(13. annual underground coal gasification symposium, Laramie, WY, USA, 24-26 Aug 1987)			
5	*See* UCRL-97245	E 1.99: DE87014231	MN -109	12:44863
6	*See* UCRL-97256	E 1.99: DE87014230	MN -109	12:44879
CONF-8708110-	(31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, San Diego, CA, USA, 16-21 Aug 1987)			
1	*See* LA-UR-87-2538	E 1.99: DE87013171	MN -34	12:46008
2	*See* UCRL-97094	E 1.99: DE87013223	MN -37	12:46133

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3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013183	MN -34A	12:46727
4	*See* SAND-86-2962C		DE87012011	MN -38	12:45982
5	*See* SAND-87-1273C	E 1.99:	DE87012102	MN -38	12:46152
6	*See* SAND-87-0382C		DE87012127	MN -37	12:46132
7	*See* LBL-22906		DE87014075	MN -34A	12:46740
CONF-8708112-	(3. international conference on superlattices, microstructures and microdevices, Chicago, IL, USA, 17-20 Aug 1987)				
1	*See* SAND-87-2038C	E 1.99:	DE87013817	MN -34	12:46779
2	*See* SAND-87-2016C	E 1.99:	DE87013928	MN -34	12:46431
CONF-8708113-	(11. IEEE biennial conference, Ithaca, NY, USA, 10-12 Aug 1987)				
1	*See* SAND-87-0686C	E 1.99:	DE87013816	MN -38	12:46032
CONF-8708114-	(1. International Society for the Advancement of Materials Process Engineers Metals and Metals Processing conference, Cherry Hill, NJ, USA, 18-20 Aug 1987)				
1	*See* UCRL-95460		DE87013496	MN -25	12:45738
CONF-8708117-	(Neutron scattering symposium on advances and applications, Sydney, Australia, 8-10 Aug 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013548	MN -34	12:46728
2	*See* BNL-40084	E 1.99:	DE87014291	MN -37	12:46103
CONF-870908-	(Course and workshop on physics of mirrors, reversed field pinches and compact tori, Varenna, Italy, 1-11 Sep 1987)				
1	*See* UCRL-97215	E 1.99:	DE87013798	MN -20b	12:46933
2	*See* UCRL-96668	E 1.99:	DE87014356	MN -20	12:46872
3	*See* UCRL-96666	E 1.99:	DE87014094	MN -20b	12:46871
CONF-870917-	(ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation, Richland, WA, USA, 13-17 Sep 1987)				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014413	MN -79	12:45348
4	*See* HEDL-SA-3633-FP	E 1.99:	DE87014385	MN -79g	12:45428
5	*See* HEDL-SA-3625-FP	E 1.99:	DE87014381	MN -79p	12:45427
6	*See* HEDL-SA-3631-FP	E 1.99:	DE87014380	MN -79b	12:45397
CONF-870942-	(4. annual Pittsburgh coal conference, Pittsburgh, PA, USA, 28 Sep-2 Oct 1987)				
1	NTIS, PC A02; 3		DE87013549	MN -114	12:45712
CONF-870947-	(12. conference on the numerical simulation of plasmas, San Francisco, CA, USA, 20-23 Sep 1987)				
2	*See* SAND-87-1693C	E 1.99:	DE87012135	MN -28	12:46088
4	*See* GA-A-18923	E 1.99:	DE87013452	MN -20d	12:46910
5	*See* GA-A-18912	E 1.99:	DE87013450	MN -20f	12:46855
6	*See* SAND-87-1870C	E 1.99:	DE87013013	MN -32	12:46986
7	*See* UCRL-96870	E 1.99:	DE87013228	MN -34A	12:46434
CONF-870959-	(International conference on neutron physics, Kiev, USSR, 21 Sep 1987)				
2	*See* UCRL-97188	E 1.99:	DE87014351	MN -34C	12:46932
CONF-870970-	(5. international conference on nuclei far from stability, Lake Rosseau, Canada, 14-19 Sep 1987)				
1	*See* UCRL-97089	E 1.99:	DE87014553	MN -34C	12:46680
CONF-870983-	(Applied superconductivity conference, Baltimore, MD, USA, 28 Sep-3 Oct 1987)				
1	*See* FNAL-TM-1450		DE87010299	STD -28	12:46082
CONF-870984-	(46. session of the International Statistical Institute, Tokyo, Japan, 8-16 Sep 1987)				
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010012	MN -32	12:46962
CONF-870987-	(IEEE international workshop on control systems in new energy applications, Madrid, Spain, 28-29 Sep 1987)				
2	*See* SAND-87-7013C	E 1.99:	DE87013997	MN -62a	12:45260
CONF-870994-	(6. conference on chemistry for protection of the environment, Torino, Italy, 15-18 Sep 1987)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010903	MN -101	12:44822
CONF-8709100-	(Hazardous materials management conference and exhibition of Canada, Toronto, Canada, 9-11 Sep 1987)				
1	*See* UCRL-97152	E 1.99:	DE87013489	MN -41	12:46200
CONF-8709104-	(ANS topical conference on population exposure from nuclear fuel cycle, Oak Ridge, TN, USA, 15-18 Sep 1987)				
2-Vugraphs	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012253	MN -41	12:45539
CONF-8709110-	(9. international free-electron laser conference, Williamsburg, VA, USA, 14-18 Sep 1987)				
1	*See* LA-UR-87-2147	E 1.99:	DE87011740	MN -28	12:46007
CONF-8709113-	(Faraday discussion on dynamics of elementary gas phase reactions, Birmingham, UK, 14-16 Sep 1987)				
1	*See* LBL-23588	E 1.99:	DE87012878	MN -34A	12:46427
CONF-8709115-	(International school of radiation damage and protection, Sicily, Italy, 24 Sep-3 Oct 1987)				
1	*See* SAND-87-1868C	E 1.99:	DE87013063	MN -34C	12:46707
CONF-8709116-	(6. international conference on solid state ionics, Garmisch-Partenkirchen, F.R. Germany, 6-11 Sep 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013553	MN -94cc	12:45941

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3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013681	MN -34	12:46729
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013552	MN -38	12:46027
CONF-8709117-	(2. biennial international machine tool research forum, Chicago, IL, USA, 1-2 Sep 1987)				
1-Draft	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014059	MN -25	12:45714
CONF-8709118-	(American Chemical Society symposium series 324, Chicago, IL, USA, 8-13 Sep 1987)				
1	*See* UCRL-95543	E 1.99:	DE87014229	MN -34C	12:46672
CONF-8709119-	(Workshop on water-cooled reactor aerosol code evaluation and uncertainty assessment, Brussels, Belgium, 9-11 Sep 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014416	MN -78	12:45443
CONF-8709120-	(International symposium on applications of ion beams in materials science, Tokyo, Japan, 2-4 Sep 1987)				
1	*See* SAND-87-1138C		DE87014158	MN -34A	12:46777
CONF-871005-	(Nuclear power systems symposium, San Francisco, CA, USA, 21-23 Oct 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008592	MN -37	12:46108
CONF-871012-	(57. annual international meeting and exposition of the Society of Exploration Geophysicists, New Orleans, LA, USA, 11-15 Oct 1987)				
1	*See* LA-UR-87-878	E 1.99:	DE87007489	MN -66b	12:44981
2	*See* LA-UR-87-877		DE87007490	MN -92a	12:44933
CONF-871013-	(5. SMORN: international conference on reactor noise, Munich, F.R. Germany, 12-16 Oct 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013181	MN -78	12:45338
CONF-871014-	(Annual meeting of the Geochemical Society, Phoenix, AZ, USA, 25-29 Oct 1987)				
1	*See* LBL-23554	E 1.99:	DE87014072	MN -11	12:46338
CONF-871018-	(International decommissioning symposium, Pittsburgh, PA, USA, 4-8 Oct 1987)				
1	*See* LA-UR-87-1773	E 1.99:	DE87010133	MN -70A	12:45126
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010588	MN -70A	12:46202
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011362	MN -11	12:46203
4	*See* UNI-SA-198	E 1.99:	DE87012226	MN -80	12:45110
CONF-871024-	(Annual meeting of Geothermal Resources Council, Sparks, NV, USA, 12-16 Oct 1987)				
1	*See* LA-UR-87-1779		DE87010134	MN -66a	12:45276
2	*See* LA-UR-87-2114		DE87011753	MN -66c	12:45289
3	*See* LA-UR-87-2083	E 1.99:	DE87011764	MN -66a	12:45288
4	*See* LA-UR-87-1918		DE87011788	MN -66b	12:45281
5	*See* LA-UR-87-2113	E 1.99:	DE87011754	MN -66b	12:45284
6	*See* LA-UR-87-2006	E 1.99:	DE87011774	MN -66b	12:45283
7	*See* LA-UR-87-1919	E 1.99:	DE87011787	MN -66b	12:45282
8	*See* LA-UR-87-2082		DE87011765	MN -66b	12:45287
9	*See* LA-UR-87-1950		DE87011784	MN -66a	12:45277
10	*See* SAND-87-1572C		DE87012015	MN -66a	12:45291
11	*See* SAND-87-1571C		DE87012369	MN -66a	12:45286
12	*See* LA-UR-87-1874	E 1.99:	DE87011792	MN -66b	12:45280
13	*See* LBL-23608	E 1.99:	DE87012884	MN -66a	12:45290
14	*See* UCRL-96157		DE87013790	MN -66c	12:46335
15	*See* LBL-23648		DE87014117	MN -66a	12:45285
CONF-871027-	(172. meeting of the Electrochemical Society, Honolulu, HI, USA, 18-23 Oct 1987)				
1	*See* LA-UR-87-643	E 1.99:	DE87006062	MN -10	12:45083
2	*See* SAND-87-0426C	E 1.99:	DE87007021	MN -94cb	12:45817
4	*See* SAND-87-0028C	E 1.99:	DE87007775	MN -4	12:45816
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009128	MN -25	12:45807
7-Summ.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009129	MN -4	12:45808
9	*See* SAND-87-1030C	E 1.99:	DE87009058	MN -25	12:45737
10	NTIS, PC A02; 3		DE87009122	MN -61G	12:45229
11	*See* SAND-87-1098C		DE87009288	MN -4	12:45818
13	*See* SAND-87-1110C		DE87009287	MN -4	12:46033
18	*See* BNL-39700	E 1.99:	DE87010063	MN -4	12:45940
21	*See* SAND-87-1189C	E 1.99:	DE87010957	MN -38	12:46034
23	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011361	MN -94c	12:45519
24	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011367	MN -4	12:45901
28	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011358	MN -94c	12:45520
29	*See* BNL-39910	E 1.99:	DE87011293	MN -37	12:46125
30	*See* SAND-87-1093C	E 1.99:	DE87012720	MN -60	12:45305
CONF-871028-	(Instrument Society of America international conference and exhibit, Anaheim, CA, USA, 5-8 Oct 1987)				
2	*See* LA-UR-87-1615	E 1.99:	DE87010117	MN -37	12:46128
3	*See* RFP-4090	E 1.99:	DE87011052	MN -32	12:46980
CONF-871030-	(Coal science international conference, Maastricht, Netherlands, 26-30 Oct 1987)				
2	*See* SAND-86-2306C	E 1.99:	DE87009541	MN -102	12:44862
3	NTIS, PC A02; 3		DE87011366	MN -102	12:44866
4	*See* BNL-39736	E 1.99:	DE87012111	MN -104	12:45186
5-Summ.	NTIS, PC A02; 3		DE87012248	MN -102	12:44867
CONF-871040-	(International symposium on pyrotechnics and explosives, Beijing, China, 12-15 Oct 1987)				
1	*See* LA-UR-87-322	E 1.99:	DE87006070	MN -45	12:46148

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2	*See* SAND-87-0618C	E 1.99:	DE87006899	MN -38	12:46149
CONF-871043-	(2. international symposium on methodologies for intelligent systems, Charlotte, NC, USA, 14-17 Oct 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007373	MN -38	12:45963
CONF-871045-	(International seminar on nuclear criticality safety, Tokyo, Japan, 19-22 Oct 1987)				
1	*See* UCRL-96681	E 1.99:	DE87010341	MN -46	12:45513
2	*See* LA-UR-87-1484		DE87010100	MN -46	12:45381
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011662	MN -46	12:45432
4	NTIS, PC A02; 3		DE87011939	MN -46	12:45378
5	*See* UNI-SA-201		DE87012227	MN -46	12:45430
7	NTIS, PC A02; 3		DE87013676	MN -46	12:45379
8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013182	MN -46	12:45087
9	*See* LA-UR-87-2532	E 1.99:	DE87013168	MN -46	12:45089
CONF-871046-	(Conference on object-oriented systems, languages and applications (OOPSLA), Kissimmee, FL, USA, 4-8 Oct 1987)				
1	*See* SAND-87-0835C	E 1.99:	DE87007341	MN -15	12:45166
CONF-871065-	(IEEE/IAS annual meeting, Atlanta, GA, USA, 19-23 Oct 1987)				
1	*See* LBL-22271	E 1.99:	DE87009159	MN -59B	12:45656
CONF-871081-	(11. annual international computer software and applications conference, Tokyo, Japan, 5-9 Oct 1987)				
1	*See* SAND-86-2384C	E 1.99:	DE87010519	MN -32	12:46981
CONF-871082-	(19. national SAMPE technical conference, Washington, DC, USA, 13-15 Oct 1987)				
1	*See* SAND-86-2983C	E 1.99:	DE87010430	MN -25	12:45815
CONF-871085-	(AEROTECH '87: Society of Automotive Engineers conference and exposition, Long Beach, CA, USA, 5-7 Oct 1987)				
1	*See* SAND-87-1370C		DE87010778	MN -38	12:45965
CONF-871086-	(Institute of Electrical and Electronic Engineers Professional Communication Society conference, Winnipeg, Canada, 14-16 Oct 1987)				
2	*See* LA-UR-87-1860	E 1.99:	DE87011797	MN -32	12:46977
CONF-871087-	(Conference of American Translators Association, Albuquerque, NM, USA, 7-11 Oct 1987)				
1	*See* SAND-87-1509C	E 1.99:	DE87010492	MN -13	12:46947
2	*See* SAND-87-1557C	E 1.99:	DE87011065	MN -13	12:46948
3	*See* SAND-87-1320C		DE87011717	MN -13	12:46946
CONF-871088-	(COMPSAC '87, Tokyo, Japan, 1 Oct 1987)				
1	*See* UCRL-96717	E 1.99:	DE87010874	MN -32	12:47007
CONF-871098-	(Fall convention of the American Society of Photogrammetry and remote sensing, Reno, NV, USA, 4-9 Oct 1987)				
1	*See* DP-MS-87-15	E 1.99:	DE87011229	MN -11	12:46233
CONF-8710101-	(31. annual Human Factors Society meeting, New York, NY, USA, 19-23 Oct 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011942	MN -2	12:45392
CONF-8710103-	(Project Management Institute seminar/symposium, Milwaukee, WI, USA, 2-7 Oct 1987)				
2	*See* SAND-86-2829C		DE87012394	MN -13	12:46950
CONF-8710104-	(AVIOS '87: voice input/output systems applications conference, Alexandria, VA, USA, 6-8 Oct 1987)				
1	*See* SAND-87-0481C	E 1.99:	DE87011636	MN -38	12:45985
CONF-8710105-	(6. conference on computers in aerospace, Wakefield, MA, USA, 7-9 Oct 1987)				
1	*See* SAND-87-0452C	E 1.99:	DE87012735	MN -32	12:46984
CONF-8710108-	(Applied geography conference, Knoxville, TN, USA, 14-17 Oct 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012523	MN -13	12:45547
CONF-8710117-	(DNA conference on instrumentation for nuclear weapon effects testing, Arlington, VA, USA, 6-8 Oct 1987)				
1	*See* SAND-87-1257C	E 1.99:	DE87012981	MN -37	12:46117
2	*See* SAND-87-1271C	E 1.99:	DE87012977	MN -37	12:46118
CONF-8710122-	(38. congress of the International Astronautical Federation, Brighton, UK, 10-17 Oct 1987)				
1	*See* BNL-40082		DE87013311	MN -2	12:46642
CONF-8710123-	(International seminar on high temperature fracture mechanisms and mechanics, Dourdan, France, 13-15 Oct 1987)				
1	*See* DOE/ER/45257-2		DE87013189	MN -25	12:45715
CONF-8710124-	(Conference on systems, man, and cybernetics, Alexandria, VA, USA, 20-23 Oct 1987)				
2	*See* LA-UR-87-2602		DE87013177	MN -32	12:46979
COO-					
3130TC-29	*See* DOE/ER/03130-29	E 1.99:	DE87014479	MN -34D	12:46109
3130TC-30	*See* DOE/ER/03130-30	E 1.99:	DE87014474	MN -34D	12:46502
3130TC-32	*See* DOE/ER/03130-32	E 1.99:	DE87014477	MN -34B	12:46110
3130TC-33	*See* DOE/ER/03130-33	E 1.99:	DE87014476	MN -34D	12:46111
3539-42	*See* DOE/ER/03539-42	E 1.99:	DE87013460	MN -34D	12:46503
3539-46	*See* DOE/ER/03539-46	E 1.99:	DE87013919	MN -34D	12:46504

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3571-24	*See* DOE/EV/03571-24	E 1.99:	DE87013690	MN -48	12:46278
CREGU-					
2	NTIS (US Sales Only), PC A13/MF A01		DE87752246	MN -51	12:45074
5	NTIS (US Sales Only), PC A16/MF A01		DE87752280	MN -51	12:45075
CRIEPI-					
218	Central Research Institute of Electric Power Industry				12:44882
285078	Central Research Institute of Electric Power Industry				12:44883
285080	Central Research Institute of Electric Power Industry				12:44823
285091	Central Research Institute of Electric Power Industry				12:45309
CRIEPI-T-					
86033	Central Research Institute of Electric Power Industry				12:44824
CRIEPI-W-					
86010	Central Research Institute of Electric Power Industry				12:44825
86016	Central Research Institute of Electric Power Industry				12:44826
CSIR-RR-					
598	CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa			ND -4	12:45952
614	*See* PB-87-197422/XAB				12:45700
CSIR-SR-CHEM-					
269	National Chemical Research Laboratory, CSIR, Box 395, Pretoria, 0001, South Africa			ND -4	12:45851
CSIRO-DG-GCM-					
65					12:44935
CTH-IEFT/PP-					
1986-05	NTIS (US Sales Only), PC A03/MF A01		DE87752426	MN -20	12:46843
1986-09	NTIS (US Sales Only), PC A02/MF A01		DE87752427	MN -20	12:46844
DCN-					
87-218-043-16	*See* PB-87-208831/XAB				12:45009
DFVLR-FB-					
86-24	*See* N-87-24673				12:46018
DOE/AL/31061-					
T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013092	MN -41	12:46711
DOE/AL/38221-					
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013102	MN -96	12:45694
DOE/BC-					
86/ 3	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001206	STD -92a	12:44977
DOE/BP-					
868	NTIS, PC A25/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014620	MN -11	12:45224
DOE/BP/13076-					
2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014302	MN -11	12:45225
DOE/BP/35475-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013427	MN -95e	12:45568
DOE/CE-					
0185	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010912	STD -95a	12:45548
0196	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014448	STD -66	12:45271
DOE/CE/15231-					
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014190	MN -95	12:45671
DOE/CE/15309-					
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014204	MN -95	12:45222
DOE/CE/15319-					
T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014112	MN -38	12:46028
DOE/CE/50052-					
H1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013577	STD -96	12:45695
DOE/CH/10093-					
6	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001140	STD -61	12:45230
12	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001171	STD -62	12:45257
DOE/CS/50028-					
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013055	MN -96	12:45696
DOE/CS/50075-					
H1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013097	MN -96	12:45707
DOE/DP/40200-					
38-Vol.29	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014468	MN -21	12:46905
46-Vol.30	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014469	MN -21	12:46003
53	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014466	MN -21	12:46906
DOE/EI/19720-					
T1	NTIS, PC A02; 3		DE87012035	MN -98B	12:44988
DOE/EI/19721-					
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011847	MN -98B	12:44989
DOE/EIA-					
0035(87/ 04)	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87012958	MN -98	12:45578
0035-87/ 05	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87014540	MN -98	12:44990
0109(87/ 05)	NTIS, PC A06/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87012959	MN -98B	12:45579
0340(86) 2	NTIS, PC A19/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87010963	MN -98B	12:44991
0380(87/ 05)	NTIS, PC A08/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87013449	MN -98B	12:44992
0438(87)	NTIS, PC A07/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87013861	MN -98	12:45552
0473(86)	NTIS, PC A04/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87013213	MN -98	12:45553

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
DOE/ER-				
0144/ 5	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87011210	STD -05	12:45549
0316	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE87012757	MN -11	12:46163
0329	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013999	MN -11	12:46327
0338	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014605	MN -34C	12:46055
0342	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014447	STD -32	12:46964
DOE/ER/03065-				
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014202	MN -34C	12:46660
DOE/ER/03130-				
29	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014479	MN -34D	12:46109
30	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87014474	MN -34D	12:46502
32	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014477	MN -34B	12:46110
33	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014476	MN -34D	12:46111
DOE/ER/03539-				
42	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE87013460	MN -34D	12:46503
46	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013919	MN -34D	12:46504
DOE/ER/04449-				
58	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012474	MN -34C	12:46651
DOE/ER/05034-				
10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014586	MN -34C	12:46643
DOE/ER/10713-				
8B	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013951	MN -34D	12:46505
DOE/ER/10810-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014162	MN -38	12:46014
DOE/ER/10902-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014015	MN -48	12:45231
DOE/ER/12019-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013688	MN -38	12:45964
DOE/ER/13103-				
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014161	MN -4	12:45943
DOE/ER/13154-				
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013663	MN -4	12:45809
DOE/ER/13215-				
1	*See* DOE/ER/10902-T1	E 1.99: DE87014015	MN -48	12:45231
DOE/ER/13290-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014188	MN -4	12:45208
DOE/ER/13323-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014452	MN -4	12:45904
DOE/ER/13336-				
2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014100	MN -11	12:46332
DOE/ER/13552-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014008	MN -4	12:45853
DOE/ER/13569-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014124	MN -4	12:45905
DOE/ER/13627-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014149	MN -48	12:45232
DOE/ER/13630-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87013459	MN -34A	12:46410
DOE/ER/25009-				
423	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013501	MN -32	12:46965
424	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013499	MN -34	12:46476
443	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013500	MN -32	12:46966
DOE/ER/25026-				
9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014401	MN -32	12:46967
DOE/ER/40130-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013391	MN -34D	12:46506
DOE/ER/40150-				
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012464	MN -28	12:46056
32	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87012466	MN -28	12:46081
DOE/ER/40200-				
107	NTIS, PC A02/MF A01; 1	DE87014582	MN -34D	12:46554
DOE/ER/40309-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014236	MN -34C	12:46644
DOE/ER/40315-				
138	NTIS, PC A02; 3	DE87009765	MN -28	12:46066
DOE/ER/40316-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014533	MN -34C	12:46645
DOE/ER/40319-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013902	MN -34D	12:46488
DOE/ER/45189-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012009	MN -34	12:46808
DOE/ER/45233-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014235	MN -34	12:46730
DOE/ER/45257-				
2	NTIS, PC A02; 3	DE87013189	MN -25	12:45715
DOE/ER/45267-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013920	MN -38	12:46021
DOE/ER/45310-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012747	MN -34	12:45716
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014011	MN -25	12:45717
DOE/ER/52127-				
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013014	MN -20	12:46845
DOE/ER/52128-				
1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87013691	MN -20	12:46907

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DOE/ER/53192-5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013454	MN -20b	12:46846
DOE/ER/53220-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013285	MN -20g	12:46847
DOE/ER/53222-95	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87013855	STD -20g	12:46848
DOE/ER/53223-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013662	MN -20	12:46849
DOE/ER/60014-01	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014125	MN -48	12:46250
DOE/ER/60076-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014163	MN -48	12:46305
DOE/ER/60197-H1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013980	STD -11	12:46328
DOE/ER/60301-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014282	MN -11	12:46212
DOE/ER/60311-3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014067	MN -11	12:46213
DOE/ER/60390-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013666	MN -41	12:46277
DOE/ER/60503-295	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013457	MN -34A	12:46411
T1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87013458	MN -34A	12:46418
DOE/ET/53088-283	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014422	MN -20	12:46850
287	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014423	MN -21	12:46851
288	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014421	MN -34A	12:46419
290	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014002	MN -20f	12:46852
292	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014424	MN -20a	12:46853
293	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014425	MN -20a	12:46854
DOE/EV/02725-12	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013895	MN -48	12:46239
DOE/EV/03280-T5	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87008950	MN -48	12:46249
DOE/EV/03571-24	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013690	MN -48	12:46278
DOE/EV/05888-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013056	MN -48	12:46306
DOE/EV/10673-T5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012996	MN -37	12:46112
DOE/EV/70032-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014165	MN -48	12:46279
DOE/FE/60177-2369	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012042	MN -123	12:45037
2401	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014001	MN -123	12:45038
2413	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014458	STD -109	12:44838
2417	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014492	STD -123	12:45055
2419	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87014900	MN -123	12:45056
2422	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE88000144	MN -123	12:45039
2423	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE88000142	MN -123	12:45040
2425	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE88000143	MN -123	12:45041
DOE/FE/60765-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87011625	MN -101	12:44962
DOE/HWP-34	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013375	STD -69	12:45854
DOE/ID/12138-7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87014462	STD -95f	12:46043
DOE/ID/12302-7	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87014461	STD -95f	12:45672
8	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87014457	STD -95f	12:45673
DOE/ID/12303-5	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87014459	STD -95f	12:45674
DOE/ID/12584-6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014446	STD -70A	12:46186
DOE/IG-0244	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830	TI87014299	STD -71	12:45088
DOE/MC/20230-2276	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87001061	STD -106	12:44839
DOE/MC/21004-2398	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006513	MN -109	12:44840
DOE/MC/22024-2339-Vol.1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE87006478	STD -103	12:44949
2339-Vol.2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006479	STD -103	12:44950
2339-Vol.3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006480	STD -103	12:44951
2339-Vol.4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006481	STD -103	12:44952
DOE/MC/22064-2407	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014776	MN -109	12:44841
2408	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014777	MN -109	12:44842
DOE/MC/23136-2342	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87006483	MN -110	12:45595
DOE/MC/23288-2406	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014778	MN -109	12:44843
DOE/MC/23289-2409	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014775	MN -109	12:44844

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DOE/METC-				
87/ 6077	NTIS, PC A21/MF A01; 1 (GPO Dep.)	E 1.99: DE87001072	MN -103	12:45310
DOE/NASA-				
0030-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014296	STD -96	12:45697
3277-4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014297	STD -60	12:45299
DOE/NBM-				
7014164	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014164	STD -94a	12:45517
7014234	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014234	MN -2	12:45569
DOE/NE/37959-				
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014227	MN -80	12:45383
10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014338	MN -78	12:45384
DOE/NE/37965-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010749	MN -80	12:45444
DOE/OR/00033-				
T314	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009954	MN -70	12:45116
DOE/PC/60050-				
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014861	MN -108	12:44845
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014862	MN -108	12:44846
DOE/PC/60797-				
16	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013070	MN -105	12:44847
DOE/PC/70771-				
T6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013752	MN -105	12:45961
DOE/PC/70795-				
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013930	MN -102	12:44869
DOE/PC/70798-				
T10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013763	MN -102	12:44870
DOE/PC/70799-				
T9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013806	MN -108	12:44848
DOE/PC/71257-				
T11	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013506	MN -108	12:44849
DOE/PC/80015-				
7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013807	MN -108	12:45187
DOE/PC/80511-				
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014006	MN -109	12:44953
DOE/PC/80516-				
8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014213	MN -113	12:44850
DOE/PC/80519-				
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014634	MN -102	12:44871
DOE/PC/80520-				
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013519	MN -105	12:44884
DOE/PC/80521-				
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014206	MN -102	12:44872
DOE/PC/80752-				
T9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014209	MN -103	12:44954
DOE/PC/80906-				
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013520	MN -108	12:44851
DOE/PC/80911-				
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014426	MN -102	12:44873
DOE/PC/90017-				
T10	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87013815	MN -108	12:44852
DOE/PC/90279-				
T8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014210	MN -104	12:44955
DOE/PC/90521-				
T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014219	MN -113	12:44853
DOE/PC/90523-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014017	MN -102	12:44854
DOE/PC/90526-				
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014557	MN -102	12:44855
DOE/PC/90529-				
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87013664	MN -102	12:44874
DOE/PETC/QTR-				
87/ 1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87014240	MN -108	12:44815
DOE/S-				
0057	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE87012897	MN -05	12:45570
0057-H6	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87013096	MN -101	12:45583
DOE/SF/15548-				
T11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014024	MN -66	12:45292
T12	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87014028	MN -66	12:45293
DOE/SR/15170-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014066	MN -11	12:46199
DOE/TIC-				
3406	NTIS, PC A15; 3	DE86013045	STD -70	12:45117
DP-				
1725	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014262	STD -10	12:45081
DP-MS-				
87-15	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011229	MN -11	12:46233
87-27	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87012920	MN -4	12:45118
87-32-Rev.1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014197	MN -70	12:45119
87-41	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012390	MN -37	12:46126
87-80	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014201	MN -70B	12:45120
87-87	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87012385	MN -70B	12:45121
DTH-LV-				
176	NTIS (US Sales Only), PC A08/MF A01; 1	DE87752863	MN -59A	12:45263

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E-				
3184	*See* N-87-23936			12:45978
3463	*See* N-87-24641			12:45980
3529	*See* N-87-23718			12:45598
3571	*See* N-87-23729			12:45729
ECE-				
EB.AIR/ SEM.1/ 3	Government of the United Kingdom			12:46164
EB.AIR/ SEM.1/ R.1	United Nations Economic Commission for Europe			12:44907
EB.AIR/ SEM.1/ R.2	United Nations Economic Commission for Europe			12:44910
EB.AIR/ SEM.1/ R.3	United Nations Economic Commission for Europe			12:44908
EB.AIR/ SEM.1/ R.4	United Nations Economic Commission for Europe			12:44909
EB.AIR/ SEM.1/ R.6	United Nations Economic Commission for Europe			12:44906
EB.AIR/ SEM.1/ R.9	Government of Denmark			12:44892
EB.AIR/ SEM.1/ R.13	Government of Finland			12:44893
EB.AIR/ SEM.1/ R.16	Government of the Federal Republic of Germany			12:44894
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ECE/COAL-				
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2152	Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK		ND -41	12:46326
2154	Electricity Council Research Centre, Capenhurst, Chester CH1 6ES UK		ND -95	12:45606
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5394	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920575	ND -109	12:44875
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5176-Vol.1	NTIS, PC A16/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87013857	MN -107	12:44887
5176-Vol.2	NTIS, PC A05/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87013684	MN -107	12:44888
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86-102(TR)	CANMET			12:44940
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10486-EN	Commission of the European Communities			12:44856
10665-EN	British Coal, London (United Kingdom)			12:44944
10666-EN	Commission of the European Communities			12:44945
10682-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -25	12:45718
10718-DE	Commission of the European Communities			12:44946
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10739-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -95	12:45562
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10875-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -13	12:45550
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86006	CRIEPI, 1-6-1 Otemachi, Chiyoda-ku, Tokyo 100, Japan		ND -97	12:45308
86007	CRIEPI, 1-6-1 Otemachi, Chiyoda-ku, Tokyo 100, Japan		ND -97	12:44964
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85-4	Natural Environment Research Council, British Geological Survey, Keyworth, Notts, England NG12 5GG	TI87900964	ND -11	12:46216
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95	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -95	12:45675
98	Electrical Power Engineers' Association, Station House, Fox Lane North, Chertsey, Surrey KT16 9HW Pound 8.95		ND -98	12:45534

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9	NTIS PC E07; Available from NTIS as TIB/B87-10488		ND -48	12:46308
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87-26-Prepr.	NTIS PC E07; Available from NTIS as TIB/B87-10822		ND -34A	12:46420
87-30-Prepr.	Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.		ND -34C	12:46647
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87/ 05	Heidelberg Univ., Germany, F.R. Physikalisches Inst.		ND -32	12:46970
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3422-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014382	MN -79h	12:45425
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3498-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014363	MN -16	12:45160
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86/ 341	NTIS (US Sales Only), PC A02/MF A01	DE87703075	MN -34D	12:46602
86/ 342	NTIS (US Sales Only), PC A04/MF A01	DE87703076	MN -34D	12:46603
86/ 347	NTIS (US Sales Only), PC A02/MF A01	DE87703077	MN -34D	12:46817
86/ 353	NTIS (US Sales Only), PC A02/MF A01	DE87703078	MN -34D	12:46585
86/ 355	NTIS (US Sales Only), PC A03/MF A01	DE87703079	MN -34B	12:46364
86/ 356	NTIS (US Sales Only), PC A04/MF A01	DE87703080	MN -34A	12:46421
86/ 357	NTIS (US Sales Only), PC A02/MF A01	DE87703081	MN -34B	12:46365
86/ 358	NTIS (US Sales Only), PC A02/MF A01	DE87703082	MN -51	12:46198
86/ 359	NTIS (US Sales Only), PC A04/MF A01	DE87703083	MN -34D	12:46818
86/ 363	NTIS (US Sales Only), PC A02/MF A01	DE87703084	MN -34D	12:46819
86/ 366	NTIS (US Sales Only), PC A02/MF A01	DE87703085	MN -34D	12:46820
86/ 369	NTIS (US Sales Only), PC A02/MF A01	DE87703086	MN -34D	12:46586
86/ 374	NTIS (US Sales Only), PC A02/MF A01	DE87703087	MN -34A	12:46733
86/ 375	NTIS (US Sales Only), PC A02/MF A01	DE87703088	MN -34D	12:46604
86/ 377	NTIS (US Sales Only), PC A03/MF A01	DE87703089	MN -34D	12:46587
86/ 378	NTIS (US Sales Only), PC A02/MF A01	DE87703090	MN -34D	12:46588
86/ 379	NTIS (US Sales Only), PC A02/MF A01	DE87703091	MN -34D	12:46821
86/ 386	NTIS (US Sales Only), PC A02/MF A01	DE87703092	MN -34D	12:46560
86/ 388	NTIS (US Sales Only), PC A02/MF A01	DE87703093	MN -34D	12:46822
86/ 391	NTIS (US Sales Only), PC A02/MF A01	DE87703094	MN -34B	12:46366
86/ 392	NTIS (US Sales Only), PC A02/MF A01	DE87703095	MN -34D	12:46823
86/ 397	NTIS (US Sales Only), PC A02/MF A01	DE87703096	MN -34D	12:46605
86/ 400	NTIS (US Sales Only), PC A02/MF A01	DE87703097	MN -34D	12:46589
86/ 402	NTIS (US Sales Only), PC A02/MF A01	DE87703098	MN -34D	12:46606
86/ 403	NTIS (US Sales Only), PC A02/MF A01	DE87703099	MN -34D	12:46590
87/ 1	NTIS (US Sales Only), PC A02/MF A01	DE87703100	MN -34D	12:46824
IFEU-				
25	Institut fuer Energie- und Umweltforschung e.V., Heidelberg, Germany, F.R.		ND -48	12:46280
40	NTIS PC E09; Available from NTIS as TIB/B87-10652		ND -11	12:46194
42	NTIS PC E14; Available from NTIS as TIB/B87-10651		ND -11	12:46195
IFSR-				
283	*See* DOE/ET/53088-283	E 1.99: DE87014422	MN -20	12:46850
287	*See* DOE/ET/53088-287	E 1.99: DE87014423	MN -21	12:46851
288	*See* DOE/ET/53088-288	E 1.99: DE87014421	MN -34A	12:46419
290	*See* DOE/ET/53088-290	E 1.99: DE87014002	MN -20f	12:46852
292	*See* DOE/ET/53088-292	E 1.99: DE87014424	MN -20a	12:46853
293	*See* DOE/ET/53088-293	E 1.99: DE87014425	MN -20a	12:46854
IFU-B-				
05/ 86	Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung		ND -61	12:45190
14-86	Forschungszentrum Graz, Austria. Inst. fuer Umweltforschung		ND -61	12:45191
IFVE-OEIPK-				
86-54	NTIS (US Sales Only), PC A02/MF A01	DE87703101	MN -34D	12:46507
86-159	NTIS (US Sales Only), PC A02/MF A01	DE87703102	MN -34D	12:46508
IFVE-OMVT-				
86-145	NTIS (US Sales Only), PC A02/MF A01	DE87703103	MN -28	12:46083
IL/ENR/BE-				
87/ 02	*See* PB-87-206322/XAB			12:45567
IMechE-				
1987-4	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ		ND -38	12:45970
INDC(EUR)-				
021/ G	*See* NEANDC(E)-282-U-Vol.3-EURATOM	DE87900963	MN -34C	12:46678
INIS-mf-				
10249	NTIS (US Sales Only), PC A11/MF A01	DE87752447	MN -4	12:45954
10654	NTIS (US Sales Only), PC A07/MF A01	DE87752467	MN -34D	12:46509
10655	NTIS (US Sales Only), PC A05/MF A01	DE87752466	MN -34D	12:46561
10656	NTIS (US Sales Only), PC A05/MF A01	DE87752465	MN -37	12:46113
10657	NTIS (US Sales Only), PC A05/MF A01	DE87752464	MN -34C	12:46662
10658	NTIS (US Sales Only), PC A09/MF A01	DE87752468	MN -34C	12:46667
10659	NTIS (US Sales Only), PC A03/MF A01	DE87752470	MN -80	12:45484
10660	NTIS (US Sales Only), PC A08/MF A01	DE87752469	MN -70	12:45124
10661	NTIS (US Sales Only), PC A11/MF A01	DE87752471	MN -2	12:45554
10698	NTIS PC E07; Available from NTIS as TIB/B87-10276		ND -34D	12:46607
10699	NTIS PC E09; Available from NTIS as TIB/B87-10624		ND -48	12:46281
10702	NTIS PC E14; Available from NTIS as TIB/B87-10705		ND -10	12:45082
10705	NTIS PC E11; Available from NTIS as TIB/B87-10676		ND -2	12:45555
10935	NTIS (US Sales Only), PC A06/MF A01	DE87703104	MN -25	12:45855
10938	NTIS (US Sales Only), PC A11/MF A01	DE87703105	MN -41	12:45485
10939	NTIS (US Sales Only), PC A02/MF A01	DE87703106	MN -41	12:45154
10946	NTIS (US Sales Only), PC A04/MF A01	DE87780161	MN -4	12:46287
10947	NTIS (US Sales Only), PC A06/MF A01	DE87702905	MN -80	12:45398
10949	NTIS (US Sales Only), PC A05/MF A01	DE87702907	MN -48	12:46255
10955	NTIS (US Sales Only), PC A04/MF A01	DE87702908	MN -2	12:46949

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
INIS-SU-					
404	NTIS (US Sales Only), PC A03/MF A01		DE87703107	MN -34A	12:46422
405	NTIS (US Sales Only), PC A03/MF A01		DE87703108	MN -34A	12:46734
406	NTIS (US Sales Only), PC A02/MF A01		DE87703109	MN -34A	12:45972
407	NTIS (US Sales Only), PC A02/MF A01		DE87703110	MN -34A	12:46735
IPPJ-DT-					
132	NTIS (US Sales Only), PC A03/MF A01		DE87702942	MN -20	12:46913
IR-					
1185	*See* NP-7900975		DE87900975	MN -116	12:44967
IS-J-					
2474	*See* DOE/ER/40200-107		DE87014582	MN -34D	12:46554
IS-T-					
1218	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013607	MN -34	12:46805
1256	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013603	MN -4	12:45857
1310	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013609	MN -34A	12:46423
1334	NTIS, PC A09/MF A01; 1		DE87013597	MN -11	12:46329
ISH-					
102	Bundesgesundheitsamt, Neuherberg, Germany, F.R. Inst. fuer Strahlenhygiene			ND -48	12:46268
103	NTIS PC E09; Available from NTIS as TIB/B87-10664			ND -51	12:46204
IWS-					
147.27B	*See* PB-87-205852/XAB				12:46174
147.32B	*See* PB-87-205845/XAB				12:46173
JA-					
5946	*See* AD-A-181792/3/XAB				12:46001
JINR-					
13-85-933	NTIS (US Sales Only), PC A02/MF A01		DE87703111	MN -37	12:46116
E-15-86-216	NTIS (US Sales Only), PC A02/MF A01		DE87703112	MN -34C	12:46652
R-1-86-67	NTIS (US Sales Only), PC A02/MF A01		DE87703113	MN -34D	12:46562
R-1-86-109	NTIS (US Sales Only), PC A02/MF A01		DE87703114	MN -34C	12:46656
R-2-86-142	NTIS (US Sales Only), PC A02/MF A01		DE87703115	MN -34D	12:46563
R-3-86-158	NTIS (US Sales Only), PC A02/MF A01		DE87703116	MN -34C	12:46665
JM-					
87-4	*See* N-87-23925				12:46015
JPL-					
9950-1299	*See* N-87-25103				12:46372
9950-1312	*See* N-87-25004				12:45771
Juel-Spez-					
373	NTIS PC E09; Available from NTIS as TIB/B87-10621			ND -25	12:45724
380	NTIS PC E11; Available from NTIS as TIB/B87-10663			ND -2	12:45556
K/ETAC-					
23	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012455	MN -38	12:46023
30	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014360	MN -38	12:45973
K/TTP-					
147	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014603	MN -22	12:45078
K/SUB-					
85-03528/ 2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014359	MN -38	12:45974
K/TR-					
87/ 1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014148	MN -22	12:45079
KC-					
86/ 02d	Korrosionscentralen, Park Alle 345, DK-2605 Broendby			ND -25	12:45725
KEK-					
86-4	NTIS (US Sales Only), PC A09/MF A01		DE87703005	MN -28	12:46057
KFK-					
4198	NTIS PC E07; Available from NTIS as TIB/B87-10828			ND -80	12:45422
4216	NTIS PC E07; Available from NTIS as TIB/B87-10662			ND -15	12:45161
4251	NTIS PC E09; Available from NTIS as TIB/B87-10826			ND -34D	12:46510
4254	NTIS PC E09; Available from NTIS as TIB/B87-10829			ND -80	12:45387
4258	NTIS PC E11; Available from NTIS as TIB/B87-10827			ND -70	12:45125
4260	NTIS PC E11; Available from NTIS as TIB/B87-10863			ND -38	12:45975
KFKI-					
1986-69/ A	NTIS (US Sales Only), PC A03/MF A01		DE87703117	MN -34D	12:46608
1986-79/ A	NTIS (US Sales Only), PC A02/MF A01		DE87703118	MN -34D	12:46825
1986-80/ A	NTIS (US Sales Only), PC A02/MF A01		DE87703119	MN -34C	12:46690
1986-96/ A	NTIS (US Sales Only), PC A05/MF A01		DE87703120	MN -32	12:46971
1986-99/ G	NTIS (US Sales Only), PC A07/MF A01		DE87703121	MN -78	12:45342
1987-01/ A	NTIS (US Sales Only), PC A02/MF A01		DE87703122	MN -34D	12:46609
1987-03/ G	NTIS (US Sales Only), PC A04/MF A01		DE87703123	MN -32	12:46972
1987-05/ G	NTIS (US Sales Only), PC A04/MF A01		DE87703124	MN -78	12:45343
KIYI-					
86-21	NTIS (US Sales Only), PC A02/MF A01		DE87703125	MN -34A	12:45726
KTM/E-B-					
53	NTIS (US Sales Only), PC A05; 3		DE87752864	MN -95d	12:45686
55	NTIS (US Sales Only), PC A04; 3		DE87752866	MN -95	12:45559

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KTM/E-D-					
123	NTIS (US Sales Only), PC A06; 3		DE87752868	MN -95d	12:45652
KURRI-TR-					
277	NTIS (US Sales Only), PC A05/MF A01		DE87780156	MN -34C	12:46648
279	NTIS (US Sales Only), PC A04/MF A01		DE87780157	MN -48	12:46293
L-					
16275	*See* N-87-24977				12:46371
LA-					
10855-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014208	MN -32	12:46973
10860-MS	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012702	STD -46	12:45380
10878	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012701	STD -34	12:46826
10920-MS	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013804	MN -32	12:46974
11005	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014708	STD -34B	12:46367
11025-M	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013441	MN -32	12:46975
11034-PR	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014704	STD -4	12:45957
11038-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014487	MN -38	12:45727
11046-PR	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87012297	MN -11	12:46234
11048-PR	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014702	STD -28	12:46058
11056-T	Los Alamos National Lab., P.O. Box 1663, Las Alamos, NM 87545		TI87013522	ND -34	12:46591
11066-MS-Vol.I	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014018	MN -66	12:45273
11066-MS-Vol.II	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014019	MN -66	12:45274
11068-M	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87014221	MN -32	12:46976
11080-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012677	MN -11	12:46147
LA-UR-					
87-322	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006070	MN -45	12:46148
87-643	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87006062	MN -10	12:45083
87-877	NTIS, PC A02; 3		DE87007490	MN -92a	12:44933
87-878	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007489	MN -66b	12:44981
87-1242	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011795	MN -28	12:46059
87-1484	NTIS, PC A02; 3		DE87010100	MN -46	12:45381
87-1615	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010117	MN -37	12:46128
87-1627	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010119	MN -34	12:46477
87-1773	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010133	MN -70A	12:45126
87-1779	NTIS, PC A02; 3		DE87010134	MN -66a	12:45276
87-1860	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011797	MN -32	12:46977
87-1862	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011794	MN -34	12:46478
87-1874	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011792	MN -66b	12:45280
87-1910	NTIS, PC A02/MF AO1; 1 (GPO Dep.)	E 1.99:	DE87011790	MN -34	12:46736
87-1918	NTIS, PC A02; 3		DE87011788	MN -66b	12:45281
87-1919	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011787	MN -66b	12:45282
87-1950	NTIS, PC A02; 3		DE87011784	MN -66a	12:45277
87-2006	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011774	MN -66b	12:45283
87-2017	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011772	MN -38	12:45698
87-2082	NTIS, PC A02; 3		DE87011765	MN -66b	12:45287
87-2083	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011764	MN -66a	12:45288
87-2113	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011754	MN -66b	12:45284
87-2114	NTIS, PC A02; 3		DE87011753	MN -66c	12:45289
87-2147	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011740	MN -28	12:46007
87-2242	NTIS, PC A02; 3		DE87013134	MN -15	12:45162
87-2243	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013135	MN -15	12:45163
87-2260	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013137	MN -25	12:45728
87-2272	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013138	MN -34	12:46737
87-2273	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013139	MN -34	12:46738
87-2283	NTIS, PC A02; 3		DE87013141	MN -34	12:46739
87-2311	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013147	MN -34A	12:46424
87-2315	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013150	MN -34A	12:46827
87-2322	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013152	MN -34	12:46425
87-2367	NTIS, PC A02; 3		DE87013157	MN -34	12:46978
87-2386	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013159	MN -34D	12:46828
87-2465	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013165	MN -37	12:45812
87-2524	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013167	MN -34	12:46479
87-2532	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87013168	MN -46	12:45089
87-2537	NTIS, PC A02; 3		DE87013170	MN -34	12:46806
87-2538	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013171	MN -34	12:46008
87-2554	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013173	MN -34	12:46480
87-2574	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87013176	MN -34D	12:46592
87-2602	NTIS, PC A02; 3		DE87013177	MN -32	12:46979
LBL-					
91-Rev.-3-87	NTIS, PC A08; 3		DE87013961	STD -34D	12:46511
8678-Rev.2	NTIS, PC A99/MF A01 - National Energy Software Center, Argonne National Lab., 9700 Cass Ave., Argonne, IL 60439 (GPO Dep.)	E 1.99:	DE85012582	MN -32	12:45653
8688-Rev.4	NTIS, PC A05/MF A01 - National Energy Software Center, Argonne National Lab., 9700 Cass Ave., Argonne, Il 60439 (GPO Dep.)	E 1.99:	DE85012580	MN -32	12:45654
8706-Rev.4-Suppl.	NTIS, PC A13/MF A01 - National Energy Software Center, Argonne National Lab., 9700 Cass Ave., Argonne, Il 60439 (GPO Dep.)	E 1.99:	DE85012581	MN -32	12:45655
22169	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014080	MN -41	12:46294
22170	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014079	MN -41	12:45976
22271	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009159	MN -59B	12:45656
22773	*See* SAND-86-7134C	E 1.99:	DE87010516	MN -70	12:45138
22820	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013973	MN -34C	12:46649

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22906	NTIS, PC A02; 3		DE87014075	MN -34A	12:46740
22993	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014688	MN -34C	12:46129
23078	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014020	MN -11	12:46166
23232	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014021	MN -28	12:46060
23240	NTIS, PC A07/MF A01; 1		DE87013968	STD -28	12:46067
23426	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014127	MN -34A	12:46426
23440	NTIS, PC A04; 3		DE87014087	MN -34D	12:46610
23483	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012887	MN -34	12:46829
23484	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012890	MN -28	12:46068
23500	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012030	MN -131	12:45016
23505	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013965	STD -48	12:46256
23509	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013964	STD -34A	12:46741
23554	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014072	MN -11	12:46338
23573	NTIS, PC A02; 3		DE87014022	MN -34D	12:46611
23588	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87012878	MN -34A	12:46427
23608	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87012884	MN -66a	12:45290
23616	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014132	MN -37	12:46130
23633	NTIS, PC A02/MFA01; 1 (GPO Dep.)	E 1.99:	DE87014119	MN -34C	12:46564
23648	NTIS, PC A02; 3		DE87014117	MN -66a	12:45285
23676	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014081	MN -34A	12:46742
23692	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012818	MN -25	12:45813
LR-					
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85-01	CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa			ND -20	12:46914
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7900962	Offshore Minerals Management, MS 646, Minerals Management Service, Washington, DC 20240	TI87900962	MN -121	12:44982
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7900975	NTIS, PC A13; 3	DE87900975	MN -116	12:44967
7900981	U.S. Fish & Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458	TI87900981	MN -11	12:46235
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87-208955/ XAB	NTIS, PC A23/MF A01				12:45684
87-209037/ XAB	NTIS, PC A02/MF A01				12:46177
87-209045/ XAB	NTIS, PC A02/MF A01				12:45543
87-209417/ XAB	NTIS, PC A03/MF A01				12:45013
87-209425/ XAB	NTIS, PC A04/MF A01				12:45325
87-209540/ XAB	NTIS, PC A05/MF A01				12:46178
87-209987/ XAB	NTIS, PC A02/MF A01				12:45014
87-210696/ XAB	NTIS, PC A07/MF A01				12:45205
87-212346/ XAB	NTIS, PC A07/MF A01				12:44985
87-213146/ XAB	NTIS, PC A03/MF A01				12:44878
87-213153/ XAB	NTIS, PC A05/MF A01				12:45015
87-214110/ XAB	NTIS, PC A06/MF A01				12:45660
PBE-					
12598-9002	Tebodin Raadgevende Ingenieurs, The Hague, Netherlands				12:44891
PEL-					
287	NTIS (US Sales Only), PC A06/MF A01		DE87703127	MN -48	12:46258
PFC/IR-					
87-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013518	MN -20	12:46862
PNL-					
5606-Vol.2	*See* NUREG/CR-4485-Vol.2		TI87014130	MN -78	12:45507
5610	*See* NUREG/CR-4418		TI87014051	MN -41	12:46295
5832-Vol.1	*See* NUREG/CR-4590-Vol.1		TI87014101	MN -80	12:45388
6078	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014622	MN -95	12:45704
6152	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE87008860	MN -70B	12:45132
6207	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014699	MN -85	12:45076
6210	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013839	MN -96	12:45701
6282	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014692	MN -61D	12:45206
6295	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014698	MN -2	12:45557
PNL-SA-					
13662	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012170	MN -34A	12:46429
14822-S	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012174	MN -85	12:45091
15094	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012683	MN -85	12:45092
PNL-X-					
765	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014388	MN -80	12:45558
PPPL-					
2448	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013199	STD -20f	12:46917
Preprint-no-					
7-86	*See* INIS-SU-406		DE87703109	MN -34A	12:45972
12-85	*See* INIS-SU-404		DE87703107	MN -34A	12:46422
17-85	*See* INIS-SU-405		DE87703108	MN -34A	12:46734
22-86	*See* INIS-SU-407		DE87703110	MN -34A	12:46735
PRI-					
112	*See* SAIC-87/1088	E 1.99:	DE87013840	STD -20g	12:46863
113	*See* SAIC-87/1089	E 1.99:	DE87014694	STD -20g	12:46864
PSD-					
87	NTIS (US Sales Only), PC A09/MF A01		DE87703128	MN -34A	12:46743
PSI-					
154/ TR-691	*See* DOE/ER/13154-9	E 1.99:	DE87013663	MN -4	12:45809
PTB-SE-					
13	NTIS PC E07; Available from NTIS as TIB/B87-10415			MN -70	12:45134
PWA-					
8/ 87	*See* KFK-4216			ND -15	12:45161
Q-					
2	*See* N-87-24211				12:45814
RCNP-P-					
80	NTIS (US Sales Only), PC A07/MF A01		DE87703016	MN -34C	12:46692
81	NTIS (US Sales Only), PC A06/MF A01		DE87703017	MN -34C	12:46653
83	NTIS (US Sales Only), PC A09/MF A01		DE87703019	MN -34C	12:46693
RE-					
156	*See* N-87-25004				12:45771
REPT-					
86-017-7767-2	*See* PB-87-203220/XAB				12:45669
RFP-					
4090	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011052	MN -32	12:46980
RHO-RE-SA-					
181-P	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010687	MN -70	12:45135
RISO-M-					
2644	NTIS (US Sales Only), PC A09/MF A01; 1		DE87752856	MN -4	12:45944

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
SAIC-					
85/ 1935	*See* AD-A-181506/7/XAB				12:46155
86/ 7539/ 129-VOL-1	*See* PB-87-200515/XAB				12:44969
86/ 7539/ 129-VOL-2	*See* PB-87-200523/XAB				12:44970
86/ 7539/ 129-VOL-3	*See* PB-87-200531/XAB				12:44971
87/ 1062	*See* AD-A-181567/9/XAB				12:46158
87/ 1088	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013840	STD -20g	12:46863
87/ 1089	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014694	STD -20g	12:46864
SAIC/QPR-					
690-6	*See* DOE/MC/22064-2407	E 1.99:	DE87014776	MN -109	12:44841
690-17	*See* DOE/MC/22064-2408	E 1.99:	DE87014777	MN -109	12:44842
SAND-					
82-2476	*See* NUREG/CR-3024		TI87014389	MN -80	12:45505
84-0173/ 2	NTIS, PC A09; 3		DE87014328	MN -11	12:46179
85-0776	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85017402	MN -80	12:45734
86-0611	NTIS, PC A15; 3		DE87009350	MN -70	12:45137
86-0957	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013591	MN -28	12:46061
86-2306C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009541	MN -102	12:44862
86-2384C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010519	MN -32	12:46981
86-2660C	NTIS, PC A02; 3		DE87012131	MN -28	12:46084
86-2829C	NTIS, PC A02; 3		DE87012394	MN -13	12:46950
86-2962C	NTIS, PC A02; 3		DE87012011	MN -38	12:45982
86-2983C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010430	MN -25	12:45815
86-2997	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014445	MN -37	12:46030
86-2998	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014444	MN -37	12:46031
86-7134C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010516	MN -70	12:45138
86-8055	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014269	MN -37	12:46131
87-0027	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012071	STD -80	12:46982
87-0028C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007775	MN -4	12:45816
87-0065	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014014	MN -34A	12:46430
87-0082C	NTIS, PC A02; 3		DE87012132	MN -28	12:46062
87-0114C	NTIS, PC A02; 3		DE87012402	MN -28	12:46085
87-0118C	NTIS, PC A02; 3		DE87013726	MN -38	12:45983
87-0129C	NTIS, PC A02; 3		DE87012021	MN -28	12:46063
87-0137C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012359	MN -28	12:46086
87-0140C-FP	NTIS, PC A02; 3		DE87011854	MN -21	12:46918
87-0162C-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009061	MN -63	12:45254
87-0179	*See* NUREG/CR-4834/1		TI87013918	MN -80	12:45508
87-0297	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014308	MN -32	12:46983
87-0315C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012362	MN -38	12:45735
87-0382C	NTIS, PC A02; 3		DE87012127	MN -37	12:46132
87-0426C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87007021	MN -94cb	12:45817
87-0452C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012735	MN -32	12:46984
87-0473	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014442	MN -38	12:45984
87-0481C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011636	MN -38	12:45985
87-0618C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006899	MN -38	12:46149
87-0686C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013816	MN -38	12:46032
87-0700	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013414	MN -32	12:46985
87-0725C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013067	MN -38	12:46024
87-0767	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014310	MN -63	12:45255
87-0768C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013937	MN -25	12:45736
87-0835C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87007341	MN -15	12:45166
87-0848	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013843	MN -28	12:46087
87-0879	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013413	MN -70	12:45139
87-0918C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013470	MN -11	12:46049
87-0927C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87014216	MN -45	12:46150
87-0954C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012737	MN -34	12:46381
87-1006C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013447	MN -38	12:45986
87-1030C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009058	MN -25	12:45737
87-1093C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012720	MN -60	12:45305
87-1098C	NTIS, PC A02; 3		DE87009288	MN -4	12:45818
87-1110C	NTIS, PC A02; 3		DE87009287	MN -4	12:46033
87-1138C	NTIS, PC A02; 3		DE87014158	MN -34A	12:46777
87-1189C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010957	MN -38	12:46034
87-1244C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012361	MN -38	12:46151
87-1257C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012981	MN -37	12:46117
87-1258	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014441	MN -62	12:45258
87-1271C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012977	MN -37	12:46118
87-1273C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012102	MN -38	12:46152
87-1320C	NTIS, PC A02; 3		DE87011717	MN -13	12:46946
87-1354C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87014215	MN -13	12:45167
87-1370C	NTIS, PC A02; 3		DE87010778	MN -38	12:45965
87-1426	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014655	MN -62a	12:45259
87-1494C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014192	MN -38	12:46035
87-1509C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010492	MN -13	12:46947
87-1557C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011065	MN -13	12:46948
87-1571C	NTIS, PC A02; 3		DE87012369	MN -66a	12:45286
87-1572C	NTIS, PC A02; 3		DE87012015	MN -66a	12:45291
87-1615C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012400	MN -37	12:46123
87-1693C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012135	MN -28	12:46088
87-1773C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012129	MN -34A	12:46778
87-1868C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013063	MN -34C	12:46707
87-1870C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013013	MN -32	12:46986
87-1916	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013655	MN -41	12:46206

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87-1917C	NTIS, PC A02; 3		DE87014159	MN -71	12:45109
87-1941C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87014155	MN -32	12:46987
87-2016C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87013928	MN -34	12:46431
87-2038C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013817	MN -34	12:46779
87-2044C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87014156	MN -34	12:46807
87-7010	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014627	MN -63	12:45819
87-7013C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013997	MN -62a	12:45260
87-7063	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013977	MN -32	12:46988
87-7066	*See* NUREG/CR-4870		TI87014339	MN -78	12:45337
87-8178	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014626	MN -62	12:45261
SAPR-					
10	*See* N-87-24387				12:46370
11	*See* N-87-24387				12:46370
SASR-					
7	*See* N-87-25259				12:46378
SBI-R-					
183	Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm			ND -95d	12:45661
186	Statens Byggeforskningsinstitut, Postboks 119, DK-2970 Hoersholm			ND -95d	12:45662
SERI/STR-					
211-3173	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001185	STD -63	12:45820
211-3174	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001184	STD -63	12:45246
211-3188	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012260	STD -63	12:45247
211-3190	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012270	STD -63	12:45248
231-3138	NTIS, PC A10; 3		DE87001189	MN -61	12:45209
SERI/TR-					
255-2993	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001195	MN -62a	12:45262
SLAC-PUB-					
4159	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012840	MN -28	12:46089
4249	NTIS, PC A02; 3		DE87013583	MN -28	12:46069
4285	NTIS, PC A02; 6		DE87011590	MN -28	12:46119
4293	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87012837	MN -28	12:46070
4336	NTIS, PC A02; 3		DE87013585	MN -34D	12:46512
4350	NTIS, PC A02; 3		DE87013587	MN -34D	12:46513
4351	NTIS, PC A02; 3		DE87013588	MN -28	12:46064
4352	NTIS, PC A03; 3		DE87013589	MN -34D	12:46612
4360	NTIS, PC A02; 3		DE87014312	MN -34D	12:46514
4364	NTIS, PC A02; 3		DE87013590	MN -28	12:46071
4366	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014314	MN -28	12:46099
4369	NTIS, PC A02; 3		DE87014315	MN -34D	12:46565
4375	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014317	MN -28	12:46090
SOL-					
87-7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013086	MN -32	12:46989
87-9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87013072	MN -32	12:46990
87-10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87014486	MN -32	12:46991
SORI-EAS-					
86-1142	*See* PB-87-208955/XAB				12:45684
SR-					
41	*See* AD-A-181273/4/XAB				12:45690
SRL-					
03-F-1987	*See* UCRL-15929	E 1.99:	DE87014237	MN -28	12:46091
SSS-R-					
87-8377	*See* AD-A-181456/5/XAB				12:46399
SSSU-					
25	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ			ND -60	12:45306
STF-					
21-A86107	*See* PB-87-205142/XAB				12:46318
SWEG-TR-					
28	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ			ND -59A	12:45267
TEL-					
187	*See* PB-87-196622/XAB				12:46402
TGAL-					
87-01	*See* AD-A-181455/7/XAB				12:46304
TK-					
65673-02	*See* NEI-FI-21		DE87752871	MN -95f	12:45681
TKK-F-A-					
609	*See* PB-87-199782/XAB				12:45518
TKK-KO/LVI-					
C29	NTIS (US Sales Only), PC A05/MF A01; 1		DE87752872	MN -11	12:45663
TNO/P-					
87/ 007	*See* AD-A-181624/8/XAB				12:46160
TRADA-RR-					
4/ 86	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks LS23 7BQ			ND -95d	12:45535
TWC-P-					
1179	*See* ETSU-WN-5028/1			ND -60	12:45302
UA-HEP-					
873	*See* SLAC-PUB-4350		DE87013587	MN -34D	12:46513
UAH-RR-					
511	*See* PB-87-207072/XAB				12:45538

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UCB/ERL-M-				
87/ 18	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013286	MN -20f	12:46865
87/ 23	NTIS, PC A03; 3	DE87013289	MN -20	12:46866
87/ 24	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87013287	MN -20f	12:46867
87/ 34	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013288	MN -20f	12:46868
UCB-PTH-				
87/ 20	*See* LBL-23440	DE87014087	MN -34D	12:46610
87/ 26	*See* LBL-23633	E 1.99: DE87014119	MN -34C	12:46564
UCD-				
472-131	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87013978	STD -48	12:46300
UCID-				
19227-86	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014318	MN -121	12:45536
20334-Rev.1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87014611	MN -37	12:46120
20442	NTIS, PC A12; 3	DE87013075	MN -70	12:45140
20839-87-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014238	MN -123	12:45821
21002-Vol.1	*See* NUREG/CR-4900-Vol.1	TI87013697	MN -80	12:45509
21002-Vol.2	*See* NUREG/CR-4900-Vol.2	TI87014129	MN -80	12:45510
21056	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014319	MN -32	12:46992
21118	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87014280	MN -38	12:45966
21123	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87013835	MN -20f	12:46869
21132	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014278	MN -32	12:46993
21143	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87014612	MN -32	12:46994
21145	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014613	MN -34B	12:46403
21146	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87014320	MN -34B	12:46180
21155	NTIS, PC A03; 3	DE87014615	MN -32	12:46995
UCRL-				
15831	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87013493	MN -11	12:46319
15915	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87014243	MN -11	12:46236
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TO Tonga
TR Turkey
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UG Uganda
US United States of America (USA)
UY Uruguay

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